ENGINEERS' HANDBOOK on Johns-Manville Power Products

D S Series 22

Johns-Manville: ***Offices in All Large Cities***

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Johns-Manville Products

Selected Data Sheets describing J-M Materials and giving information for specific applications

JOHNS-MANVILLE
JM
PRODUCTS

Johns-Manville
Executive Offices: 22 East 40th Street, New York
Offices in all Large Cities

Printed in U. S. A.

This Data Sheet Book

THE following pages describing Johns-Manville products and their uses have been selected from the complete J-M master set, which consists of several thousand technical data sheets, compiled in collaboration with the engineering staff and the research laboratory. Only authoritative sources have been used and every attempt has been made to be informative and accurate. However, no guarantee is implied in any statement.

Where possible, information on uses and applications of special interest to the reader have been included. The wide range of services in which the various J-M materials are used often necessitates the presentation of commodity information in general terms, including characteristics, uses, advantages, and methods of application. From these data, the reader can estimate the value of a J-M product for the particular installation.

Illustrations, where used, are intended to assist the reader in visualizing commodities and application methods and to show some typical installations. Because of the wide utility of many products, installation pictures can show only a few typical uses.

This book is arranged in order of commodity classification. Page numbers merely indicate the location in the master set and identify the individual sheet. The lack of consecutive numbering does not imply missing pages; it is only the result of the selective process used in compiling the book.

In order to assure the circulation of the latest available information, this and other data sheet collations are assembled and bound only on request.

Additional information on J-M products and their uses in special applications can be secured by writing to **Johns-Manville**, 22 East 40th Street, New York, N. Y.

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J-M Systems of Sound Control

J-M Systems of Sound Control provide the means for overcoming a great variety of sound problems. The acoustical treatment and sound isolation used in Station WWJ, Detroit, Mich., assure brilliance to the studio and fidelity to the program

The control of sound is every day becoming increasingly imperative to human health, comfort and efficiency. Wherever groups of people gather indoors for entertainment, worship or education, the problem of room acoustics or hearing conditions nearly always arises. In places where people work, study or eat, the need for sound-quieting is urgent. This is even more true in hospitals and sanitariums. The problem in other places, such as in machinery rooms, becomes one of sound isolation, the control of sound transmission and vibration.

For many years, Johns-Manville has pioneered in the solution of these sound control problems. The practical applications of control principles are predicated upon the researches of Professor Wallace C. Sabine of Harvard, who reduced the subject of sound as it relates to building interiors to an exact science. Retained by Johns-Manville as acoustical consultant, Professor Sabine carried forward his studies in collaboration with the J-M Research Laboratories, which still continue his work. As a result of these studies many techniques and materials have been developed; these serve as a basis for the J-M Systems of Sound Control through which thousands of acoustical difficulties have been overcome.

The Engineering Problem

Upon the researches of Professor Sabine are based the science of constructive and corrective acoustics, as applied to auditoriums and public buildings, and the noise reduction principles used in quieting offices, factories and hospitals. Professor Sabine discovered that poor hearing conditions result from reverberation, the persistence of sound after its source has ceased. This phenomenon is caused by excessive sound reflections from the walls and ceiling. These reverberations prevent the listener from distinguishing successive words or sounds as definite and separate elements. The result, to the listener, is irritation, confusion and consequent lack of intelligibility. Excessive sound reflections are also responsible for much of the din which prevails in offices, factories and other places where machinery is used. Professor Sabine concluded that through the use of certain materials the sound waves could be satisfactorily absorbed and excessive reflections eliminated.

He proceeded to work out a method of calculating the duration of reverberation under various conditions. This, he expressed in the formula, $T = \frac{.05\ V}{a\ \ S}$, wherein T equals the reverberation time in seconds; V

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In addition to quieting the disturbing noise, the Sanacoustic ceiling in the Toronto office of Colgate-Palmolive-Peet Co., Ltd., also affords the maximum of light reflection

represents the volume of the interior in cu. ft.; *a* is the average coefficient of all reflecting surfaces, allowing for the relative area of each type of surface; and *S*, the total surface. The product of *a* x *S* gives the number of absorption units in the room. An absorption unit is theoretically based upon the area of an open window one foot square from which, of course, no sound would be reflected. By comparison with this unit, the efficiency of all acoustical and sound-absorbing materials is measured.

A study was then made of rooms considered acoustically acceptable by average audiences. This revealed a direct relationship between the volume of sound and the number of absorption units necessary to reduce the reverberation to an optimum time. From these data, were plotted curves which enable the competent acoustical engineer to calculate, in advance of construction, the acoustical or hearing qualities of an auditorium. In a similar manner existing buildings may be accurately analyzed.

Further studies have developed methods to measure noise that results from necessary machine operations. In addition, a technique for isolating sound at its point of origin has been devised. As a result of this broad background of research, Johns-Manville has corrected many thousands of installations requiring the control of sound.

Practical Application:

The first general division of sound control embraces the improvement of audition in theatres, auditoriums and churches. It deals with the elimination of echoes, excessive reverberation and extraneous noises. With proper acoustical treatment, the audience may enjoy the entertainment or hear the speaker with ease. The treatment is effected with sound-absorbing materials applied to the reflecting surfaces.

Sound-absorbing treatments for the reduction of noise-level constitute the second general division. These treatments are applied in offices, banks, schools, hospitals and, in fact, wherever objectionable noise is produced. Through the use of such treatments, protection is afforded against discomfort, distraction and irritation from excessive noise. These first two groups are sometimes classified together as acoustics for room interiors.

Sound isolation, the third general division, involves the prevention of sounds and vibrations generated in one place from reaching another through interposing partitions, ceilings or floors. It includes the treatment of such locations as bowling alleys and broadcasting studios as well as machinery rooms. The underlying principles of sound isolation are entirely different from those employed to correct interiors for air-borne sound. However, in many cases both types of treatment are necessary as in broadcasting studios.

The control of machine noise makes up a fourth general group. This division often proves to be complex and quite different from those which involve the ordinary problems of room acoustics or vibration control. The most effective way to avoid noise generation in mechanical equipment is through careful designing, manufacturing and testing. Remaining noises can usually be controlled by proper treatment.

In all the other divisions of sound control, as in equipment-quieting, the proper planning and choice of materials, prior to building, permits considerable economy. However, it is usually feasible to apply corrective measures after erection of the structure.

Selection of Materials

In choosing a sound control material, the factors of chief importance are the efficiency of the material to absorb sound in the frequencies encountered, low maintenance cost and fire resistance. Where an acoustical installation acts as a surface of the room interior, other primary considerations include ease of cleaning, paintability, light reflection coefficient and decorative qualities of the material.

An analysis of any sound control problem can be obtained by writing to the nearest Johns-Manville office. Without obligation, a J-M engineer will study the conditions and suggest a suitable treatment.

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Description of Materials

There is a Johns-Manville sound control material available for every type of acoustical problem:

Sanacoustic, in tile design, because of its high degree of sound absorption, low maintenance cost and permanence, is widely recognized as the ideal acoustical material. Made up of metal, mineral wool and asbestos, the unit will not burn, rot or disintegrate. Sanacoustic consists of a perforated and enameled sheet-metal casing, which contains a special rock wool pad—the sound-absorbing medium. The units lock into tee bars, which are mechanically fastened to the surface to be treated. This method of erection enables a Sanacoustic installation to be taken down and relocated without loss of materials.

The face of the rock wool pad is left exposed behind the perforated metal to assure the maximum absorption of sound, especially at the higher frequencies. The back and edges of the pad, however, are covered with asbestos paper which keeps the units clean longer by preventing the infiltration of air.

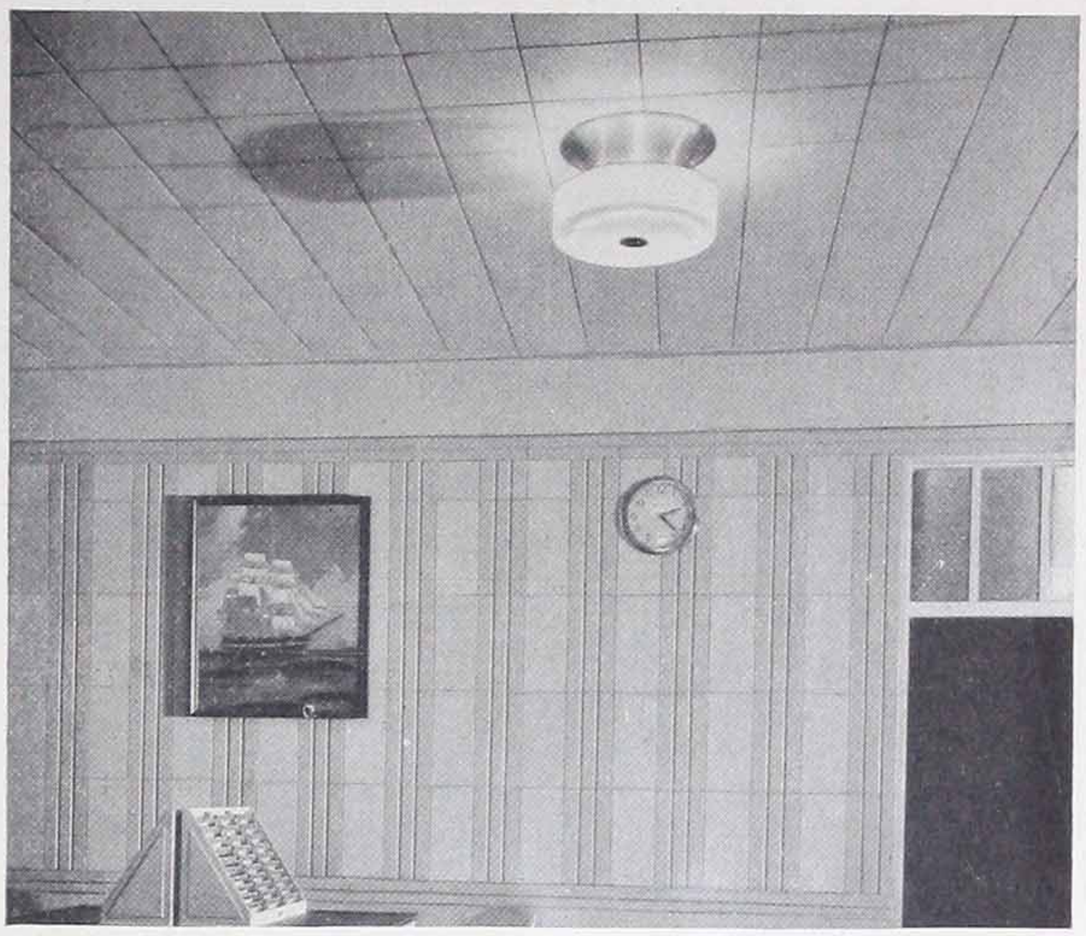
The enamel that is baked on the perforated metal facing is tough and durable and it may be washed repeatedly without injuring the finish. Sanacoustic also may be painted without loss of sound-absorbing efficiency, although this is unnecessary unless a change of color is desired. The permanence of the enameled-metal surface and the ease with which it may be cleaned assure low maintenance costs.

Sanacoustic, tile design, is available in standard white or standard cream enamel, in wood grain finish and in polished or enameled aluminum. Standard sizes are 12″ x 12″, 16″ x 16″ and 12″ x 24″. Attractive pre-decorated designs are also available in the 16″ x 16″ size.

Sanacoustic Panels have all the advantages of Sanacoustic, tile design, and, in addition, afford great flexibility of unit size. Steel panels with a priming coat of baked cream enamel are available in the following sizes: 96″, 120″, 144″ and 168″ long by 30″, 36″, 42″ and 48″ wide. In aluminum the same sizes can be furnished up to 48″ x 120″.

The rock wool blanket used as a sound-absorbing element possesses the same qualities and characteristics as the pad used in a unit of Sanacoustic.

Sanacoustic Ventilating Ceiling, besides quieting room noise, also affords uniform distribution of air. It consists of a suspended ceiling of 12″ x 24″ Sanacoustic units so installed that the furred space becomes a plenum chamber for the air-conditioning system. The thousands of perforations in each Sanacoustic unit serve as supply openings, through which air flows slowly and noiselessly into the room.



Sanacoustic is suited to a wide range of architectural effects. Office of the Manteno State Hospital, Manteno, Ill.

A slight air-pressure is built up in the plenum chamber behind the Sanacoustic Ventilating Ceiling and air is carried past the sound-absorbing pad to the perforated metal surface through Air Flow Channels.

Acoustex is a fire and moisture-resistant acoustical material made of wood fibre. It is particularly applicable in offices, schools, churches and gymnasiums where a sound-absorbing material giving a tile pattern or plank effect in harmonizing colors is desired.

Acoustex is available with a priming coat of light buff lacquer for painting and also in standard colors of white, light buff, medium buff, dark buff, light gray and apple green. The natural texture of the wood fibre, however, is unusually pleasing and, being light buff in color, has a high coefficient of light reflection. Other colors may be had on special order.

Acoustex is supplied 6″ x 12″, 12″ x 12″, 6″ x 24″, 12″ x 24″ and 24″ x 24″, in thicknesses of 5/8″, 3/4″, 7/8″, and 1 1/8″. It is also available in planks of 6″, 12″ and 24″ wide, lengths up to 96″. Cement and nails are used for installation. For suspended ceiling construction, which eliminates the need for lath and plaster, Acoustex is furnished 24″ wide in lengths from 24″ to 96″, 7/8″ and 1 1/8″ thick.

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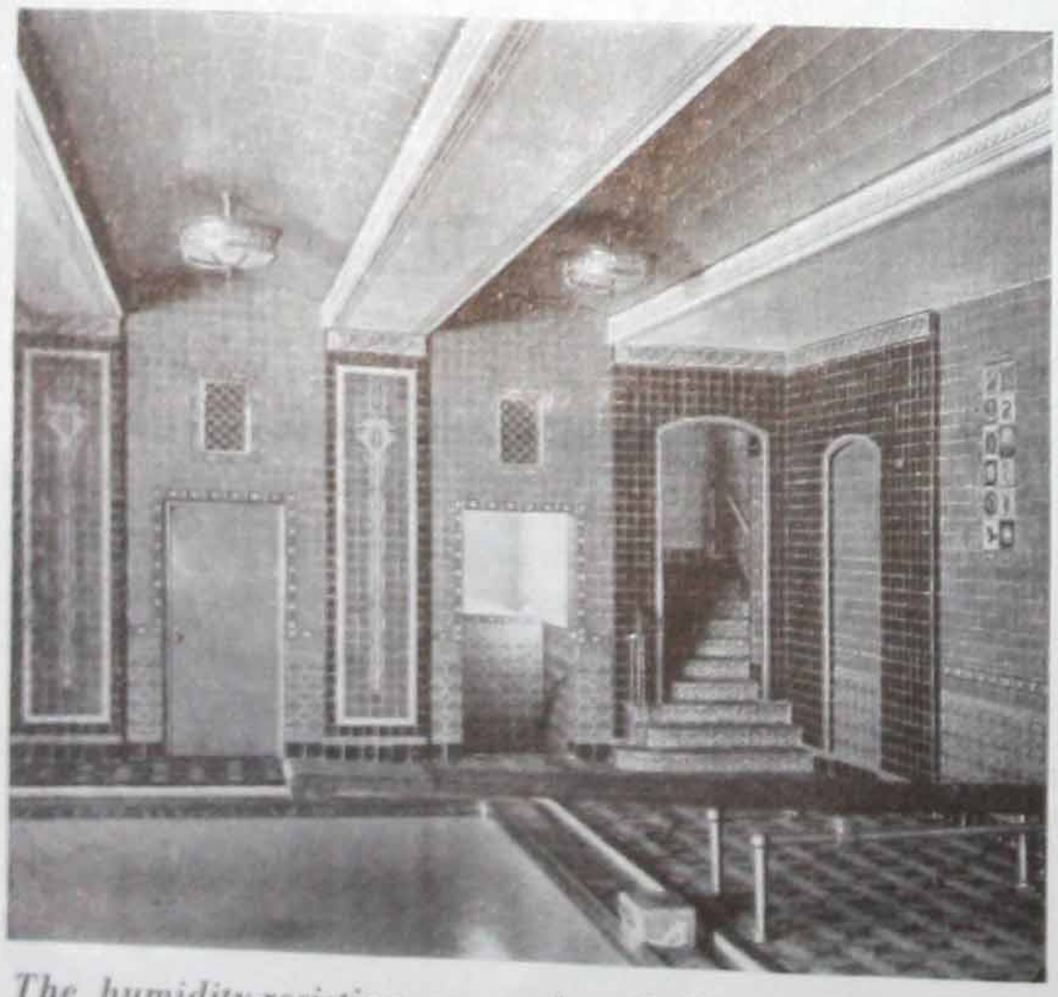
The beauty and effectiveness of this Acoustex installation adds to the dignity of the Panel Room of Schrafft's Restaurant, 625 Madison Avenue, New York, N. Y.

Transite Acoustical Units, a utilitarian material, consist of perforated Transite and a rock wool sound-absorbing element backed with asbestos paper. The Transite facing is a cement-asbestos product which has been used for many years on industrial building exteriors and which has great resistance to moisture and corrosive fumes. The units, made entirely of minerals, are particularly fire-resistant. Embodying these properties, this Transite-faced acoustical material is ideal for chemical laboratories, gymnasiums, swimming pools, as well as offices and auditoriums.

Brass grommets, inserted in the corners of each unit, fasten the sound-absorbing element and the facing together, and also provide openings for nailing through the unit to the furring strips.



The humidity-resisting properties of Transite Acoustical Units make this material especially suitable for swimming pool installations. New Y. M. C. A., Harrisburg, Pa.

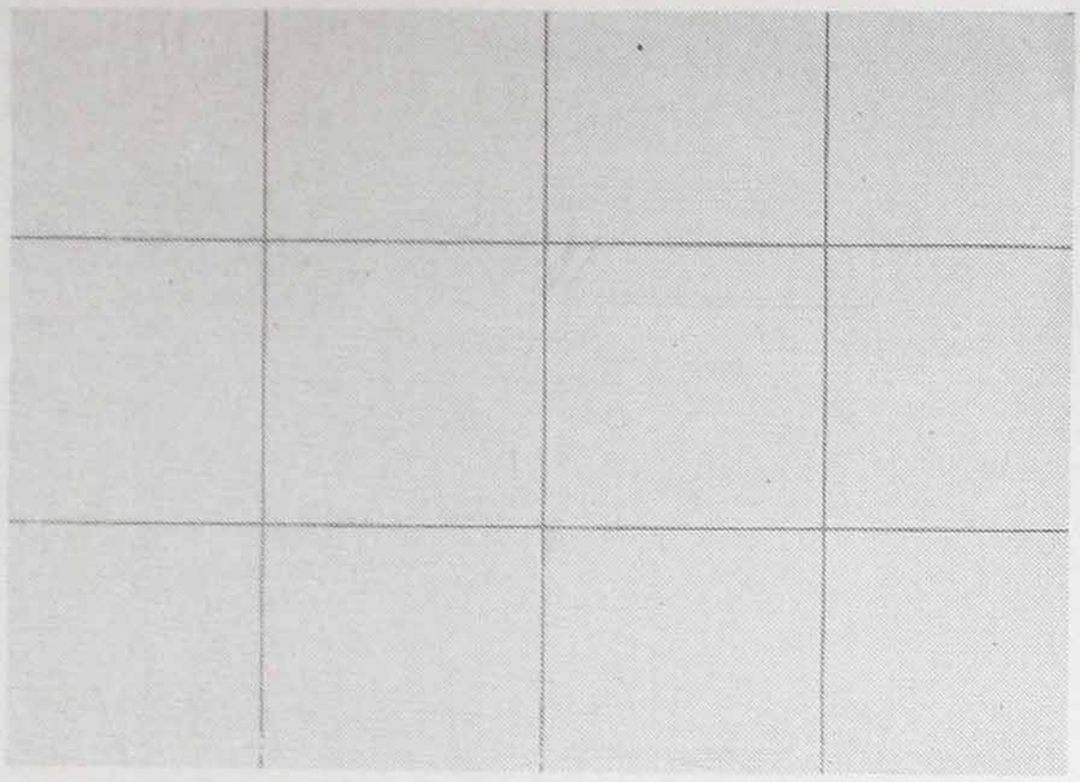
The units are furnished in a natural finish buff and a cream white finish in pieces 12″ x 12″, 1⅛″ thick.

Transite Acoustical Panels consist of large sheets of perforated Transite backed by a rock wool sound-absorbing element. They are similar in properties to Transite Acoustical Units with the added advantage of being larger. The panels are available in natural finish buff with beveled or square edges and in cream white finish with beveled edges only. Standard sizes are 12″ x 12″, 12″ x 24″, 24″ x 24″ and 24″ x 48″.

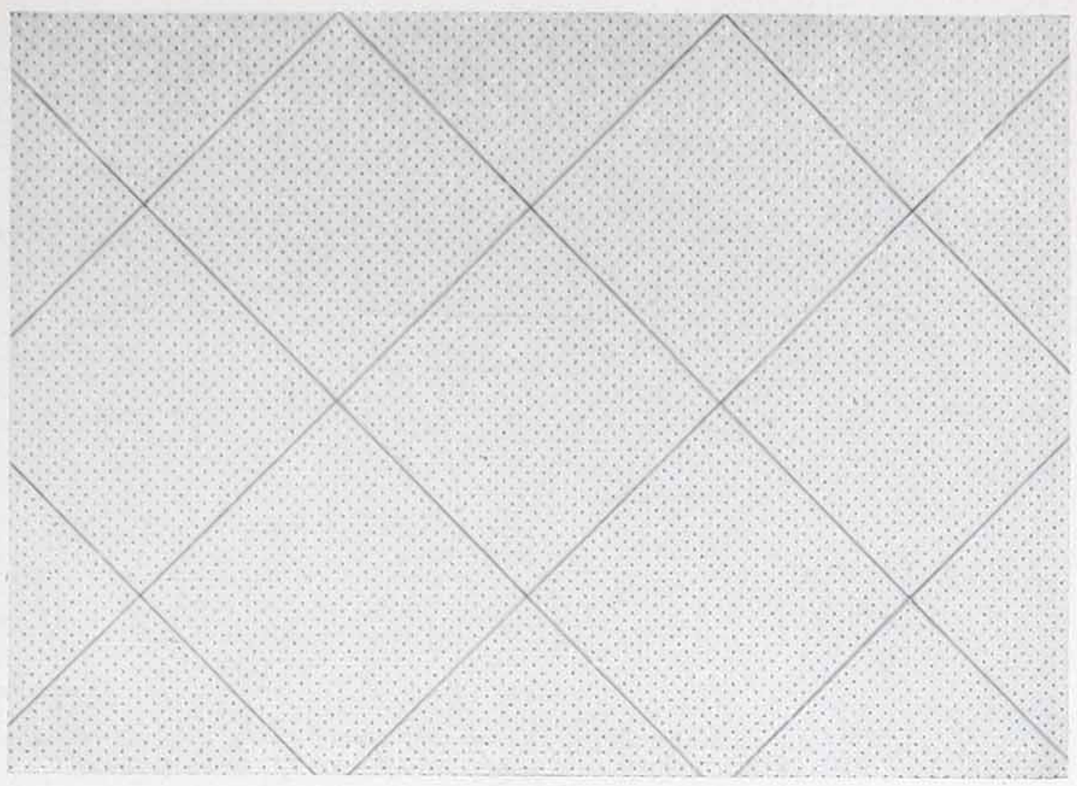
The appearance of an unbroken perforated area can be had by ordering unbeveled Transite Acoustical Panels in sizes 23⅞″ x 23⅞″ and 23⅞″ x 47¾″.

Rockoustile is a distinctively attractive acoustical material manufactured from mica which has been expanded by the application of heat. Its natural color is an iridescent golden ecru, but it is also furnished with an ivory cream finish. On special order, the material may be had in light-reflecting flat white and in slightly varying pastel shades of gray, buff, blue or any other color. It is supplied square-cut or bevel-edged, in sizes 6″ x 12″, 12″ x 12″ and 12″ x 24″, 1″ thick. Usually applied with nails and cement.

Nashkote Acoustical Finishes offer an acoustical treatment consisting of Asbestos Akoustikos Felt cemented to the surface to be treated and covered with a membrane. The membrane, which is secured with Acoustical Size, may be painted muslin (Nashkote Types A and AIS in which Type A resembles smooth plaster, AIS sand-finished plaster) or it may be Type F which has a membrane of high quality burlap. Other textiles such as canvas or rep may be used as a covering; sometimes no membrane is affixed.



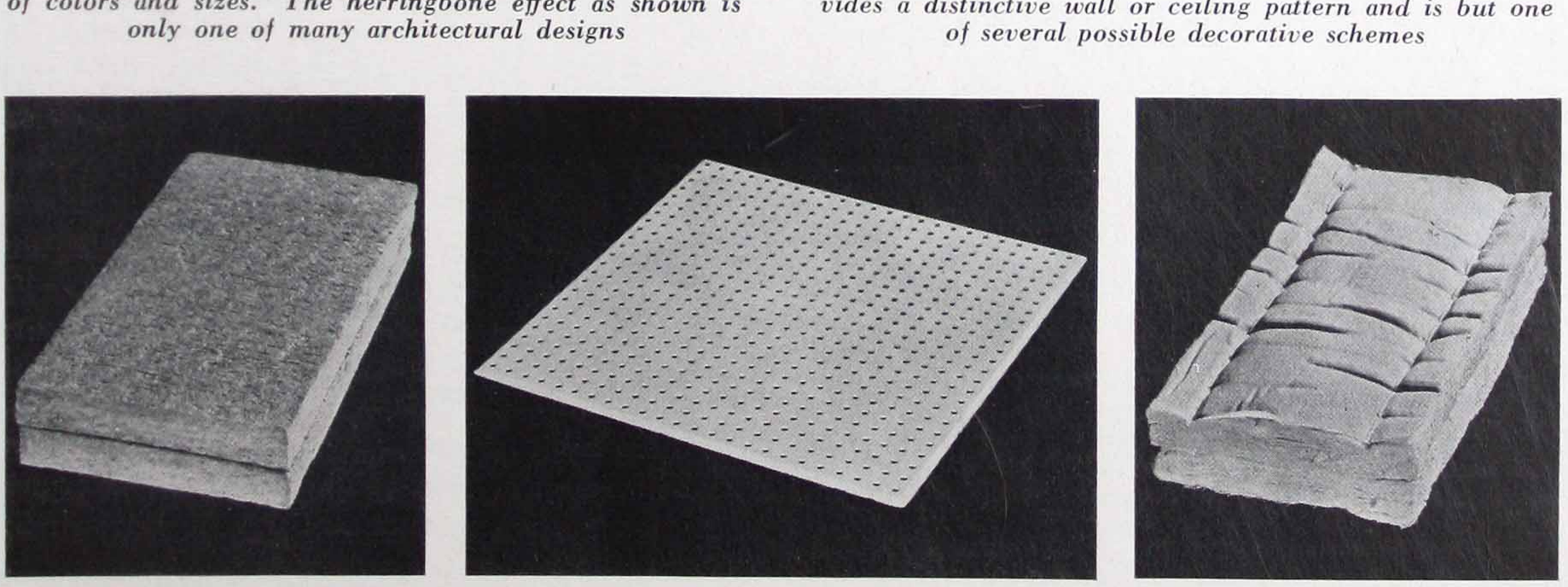
Sanacoustic, tile design, is the best general sound control material available because of its excellent sound-absorbing efficiency, permanently high light-reflection factor and extremely low maintenance cost



Transite Acoustical Units are unusually resistant to moisture, steam and corrosive fumes. This utilitarian material is ideal for use in chemical laboratories, kitchens, dishwashing rooms and swimming pools

Acoustex is particularly suited to locations that require a smooth, textured material. It is available in a wide range of colors and sizes. The herringbone effect as shown is only one of many architectural designs

Rockoustile is an exceedingly attractive acoustical material with an open texture. The broken joint construction provides a distinctive wall or ceiling pattern and is but one of several possible decorative schemes



Broadcasting and Recording Studio Treatment corrects reverberation and assures faithful sound reproduction. The Transite Acoustical Panel, center, is used over the rigid Studio Element, left, or Sound Isolation Blanket, right, to achieve the correct acoustical balance.

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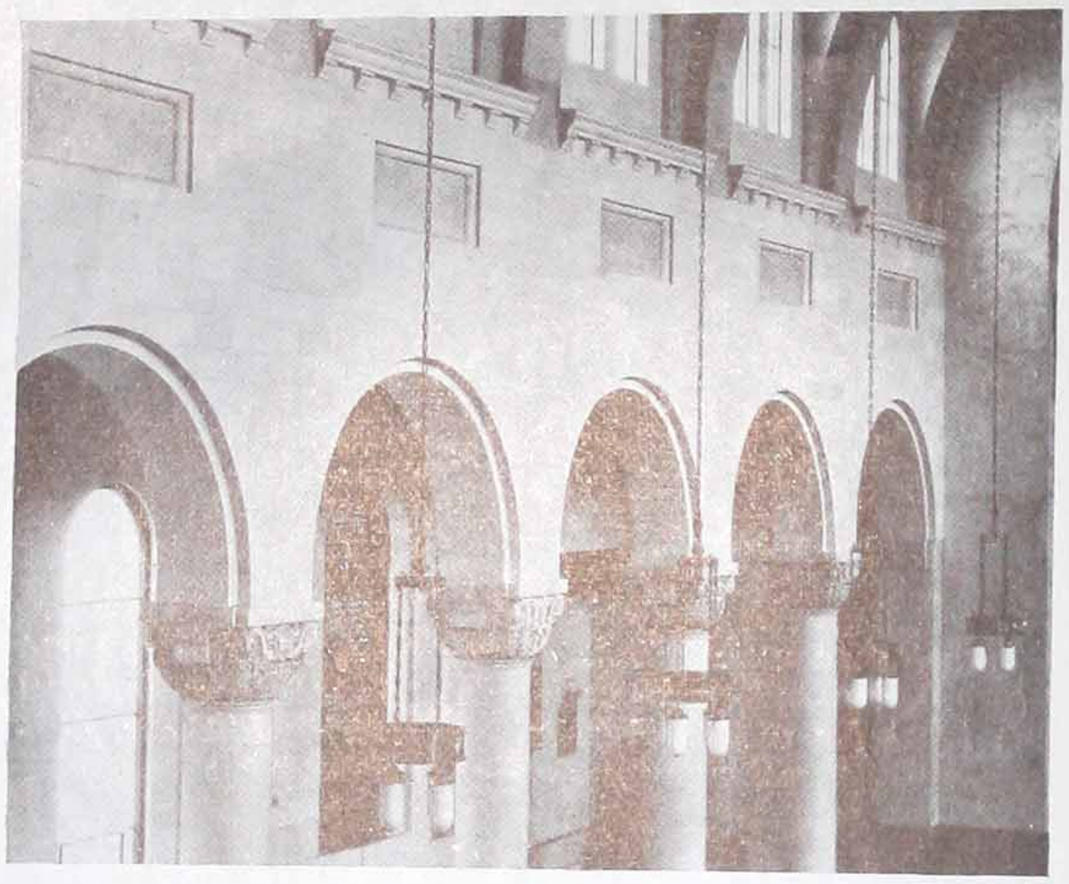
Additional Materials and Accessories



In addition to correcting the echo, J-M acoustical materials have beautified St. Anslem Church, Pittsburgh, Pa.

Following are descriptions of additional J-M sound control materials which cover a wide variety of conditions and locations. Also included are accessories for the installation of treatments.

Acoustical Cement, No. 130, an adhesive for cementing asbestos Akoustikos Felt, is supplied in 1, 3, 5 and 50-gal. containers. One gallon, with 40 percent added alcohol, will cover approximately 100 sq. ft. of smooth plaster.

Acoustical Cement, No. 132, is used for spot-cementing rigid acoustical units. Furnished in 1, 3 and 5-gal. containers. One gallon accommodates about 30 to 40 sq. ft. of units.

Acoustical Size is used to set the surface of Akoustikos Felt and to secure the finishing membrane of muslin. Furnished in 1, 5 and 50-gal. containers. For sizing, one gallon, with one gallon added water, will cover 200 sq. ft. For applying muslin, one gallon, with 40 percent added water, will cover 100 sq. ft.

Asbestos Akoustikos Felt, made of asbestos fibre and selected hair, is used where a flexible sound-absorbent is necessary. Supplied in approximately 160-ft. rolls of ¼", ½", ¾" and 1" thicknesses, weighing 40, 68, 98 and 128 lbs., respectively. Rectangular-cut or die-cut shapes made on special order.

Air Flow Channels are passageways governing the amount of air transmitted from the plenum chamber of the Sanacoustic Ventilating Ceiling into the room. Available 24" long with 10, 6, 3, or 1 openings—also blank for special use.

Anti-Vibration Platforms are constructions which utilize Sound Isolation Chairs and usually Sound Isolation Fill to prevent machine vibrations from being transmitted to supporting structures.

Banacoustic Blankets are fireproof acoustical blankets made from white, long-fibre rock wool, felted and secured between various types of binders. The material is usually covered with decorative cloth or placed behind ornamental grilles. Blankets also utilized to quiet mechanical equipment. Flame-proofed muslin one side is standard with Style No. 100; it may be had on all other styles on special order. Available in thicknesses of 1", 1½" or 2" and standard sizes of 24" x 48" and 24" x 96", unless specified otherwise. The table at the top of the other column describes the binders used on the various styles of Banacoustic Blankets.

Standard Types of Banacoustic Blankets

Style No.	Type of Cover
100	1" wire mesh one side, 3" stucco lath with flame-proofed muslin under lath. (1" thick only)
102	1" wire mesh both sides
112	1" wire mesh and metal lath
122	Metal lath both sides
132	1" wire mesh and ⅜" rib lath
132-A*	Same as No. 132 except rib turned out
142	Metal lath and ⅜" rib lath
142-A*	Same as No. 142 except rib turned out
152	1" wire mesh and ¾" rib lath
152-A*	Same as No. 152 except rib turned out
162	Metal lath and ¾" rib lath
162-A*	Same as No. 162 except rib turned out
172**	⅜" rib lath both sides
182	Asbestos paper both sides. (Size 24" x 48" only)
192	No. 12 mesh fly-screen wire both sides

* The turned-out rib provides air space.

** Ribs may be turned in or out, and run lengthwise or across the blanket, or at right angles to each other, as specified.

Broadcasting and Recording Studio Treatment is designed for broadcasting and sound film studios. The treatment utilizes rigid Studio Elements, 2" thick, covered with decorated sheets of perforated metal or Transite applied to walls and ceilings. Sound Isolation Blankets, 2" and 4" thick, are sometimes used.

Sound Isolation Blankets Types KA, KK, MK and MM are composed of ½", 1" and 2" rock wool, stitched between sheets of various materials. Type KA has asbestos paper one side and flame-proofed Kraft paper the other; Type KK has flame-proofed Kraft paper both sides; Type MK, flame-proofed Kraft paper one side and flame-proofed muslin the other; Type MM, flame-proofed muslin both sides. Types KA and KK are furnished 36" wide in rolls 65, 35 and 18 ft. long, decreasing with increase of thickness. Types MK and MM are supplied 22" or 36" wide in rolls 50 ft. long for ½" and 1" thickness and 25 ft. long for 2" thickness and can be had with sealed or unsealed edges.

Sound Isolation Chairs and Wall or Ceiling Isolators are shock-absorbing units, shaped like stirrups, that are lined with punched felt. They are placed between the supporting structure and floated floors, walls or ceilings thereby reducing the transmission of vibrations of all kinds, including those induced by mechanical means and by air-borne sound.

Sound Isolation Fill consists of rock wool, used in the space between the finished floor and the floor structure as a sound-damping medium and to prevent drum action. Also used in Anti-Vibration Platforms for the same purpose.

Transite Acoustical Wainscoting is an acoustical material that is used where only a wainscoting treatment is necessary or desired. It consists of perforated Transite panels applied over a 10½" x 18", rock wool, sound-absorbing element, 1" thick. The panels, 2 ft. wide x 4 ft. high with beveled edges on the vertical sides, are screwed to the furring. The treatment is finished with a metal cap at the top and an unperforated Transite base.

Occasionally materials that were designed primarily for the quieting of mechanical equipment can be advantageously adapted to acoustically treat room interiors. Descriptions of these J-M products may be found on other data sheets under the heading, Sound Control of Mechanical Equipment.

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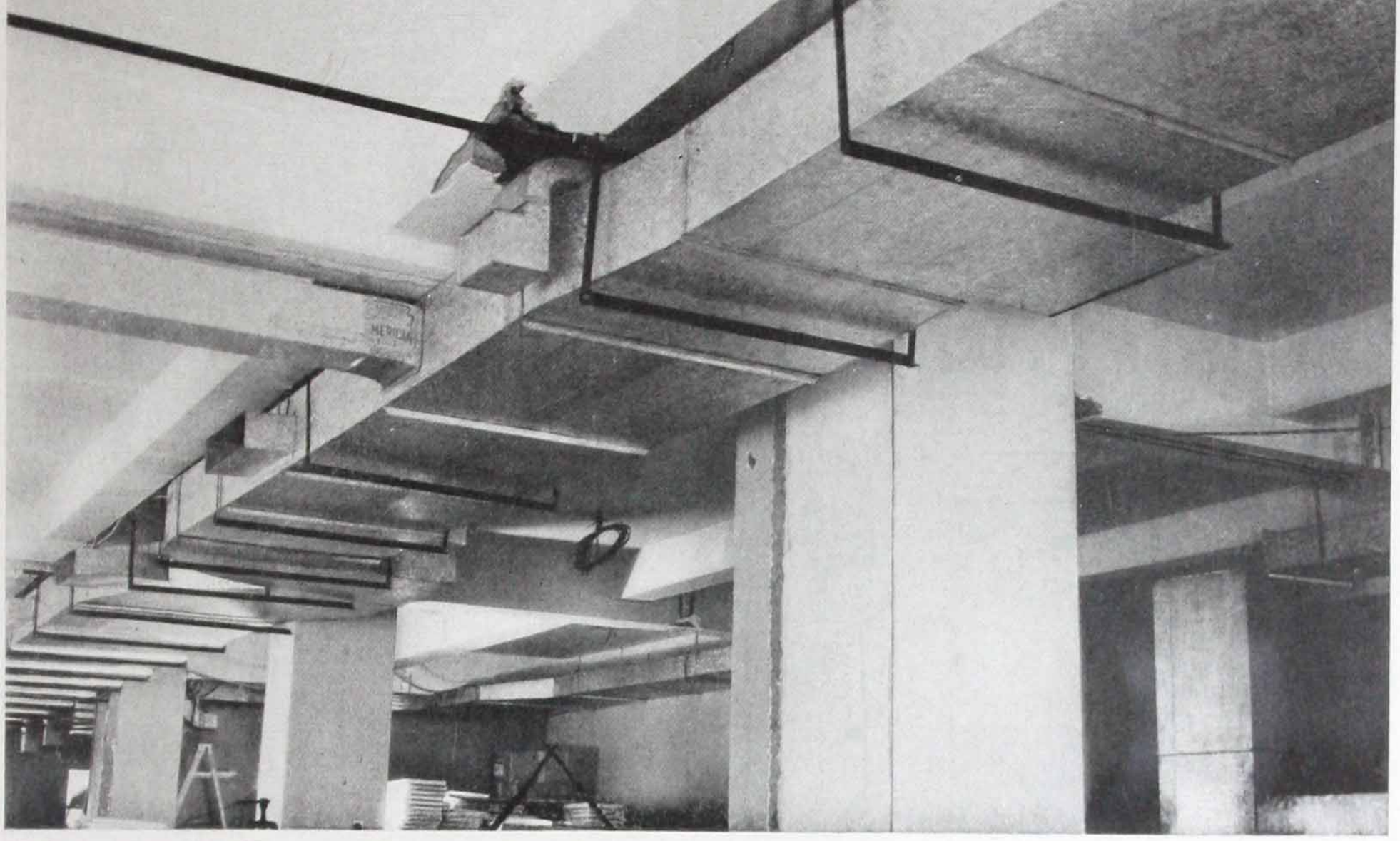
Sound Control of Mechanical Equipment



In modern building construction, air-conditioning ducts are everywhere in evidence. Mechanical noise and conversation carried through these air-ways result in the most annoying irritation and loss of privacy, unless the ducts are lined with effective sound absorbents at strategic locations. Air-Acoustic Sheets were developed by Johns-Manville especially for this purpose

Mechanical equipment, introduced into both residences and working spaces, has caused the occupants to become increasingly conscious of the growing amount of noise. Air conditioning, the use of individual power plants, the ubiquitous elevator, pumps and allied mechanical equipment, all involve the use of power and moving parts. Unless steps are taken to confine the resulting noise, dissatisfied customers, with attendant complaints and loss in revenue, are the inevitable consequence.

The control of machine noise, so damaging to human comfort and efficiency, often proves to be complex and quite different from ordinary problems of both room acoustics and vibration control. Occasionally it is purely a matter of controlling either airborne sound or machine vibrations, more often the problem involves both sound absorption from the air and sound isolation. The difficulty of treatment is further enhanced by limitations of design which often restrict the application of sound control materials.

Care in planning, manufacturing and testing of mechanical appliances is undoubtedly the most fruitful means of avoiding noise problems arising from such equipment. Once originated, the noise can be somewhat controlled but the best job of all is one that can be performed in the mechanical division of a manufacturer's plant. Careful design and alignment of moving parts and the proper use of lubricants, combined with routine inspection based on laboratory analysis, offers an almost complete solution to many an annoying noise condition.

Assuming that the best possible mechanical job has been done, the problem becomes one of air-borne sound or vibration or both. The one form of energy is readily transformed into the other and thus arise the difficulties of quieting mechanical equipment.

If vibration is being transmitted to foundation or housing, the latter may act as a sounding board. In this case, the isolating or divorcing of the vibration-provoking mechanism from the rest of the unit may alone provide the required degree of quiet. Vibration of the smaller mechanical units is less frequently a cause of difficulty now than it was a few years ago because of the attention given to this problem by equipment manufacturers. However, the sound which the mechanical part itself radiates to the air may be so great and the barrier provided by the conventional sheet metal housing so inadequate that the problem is

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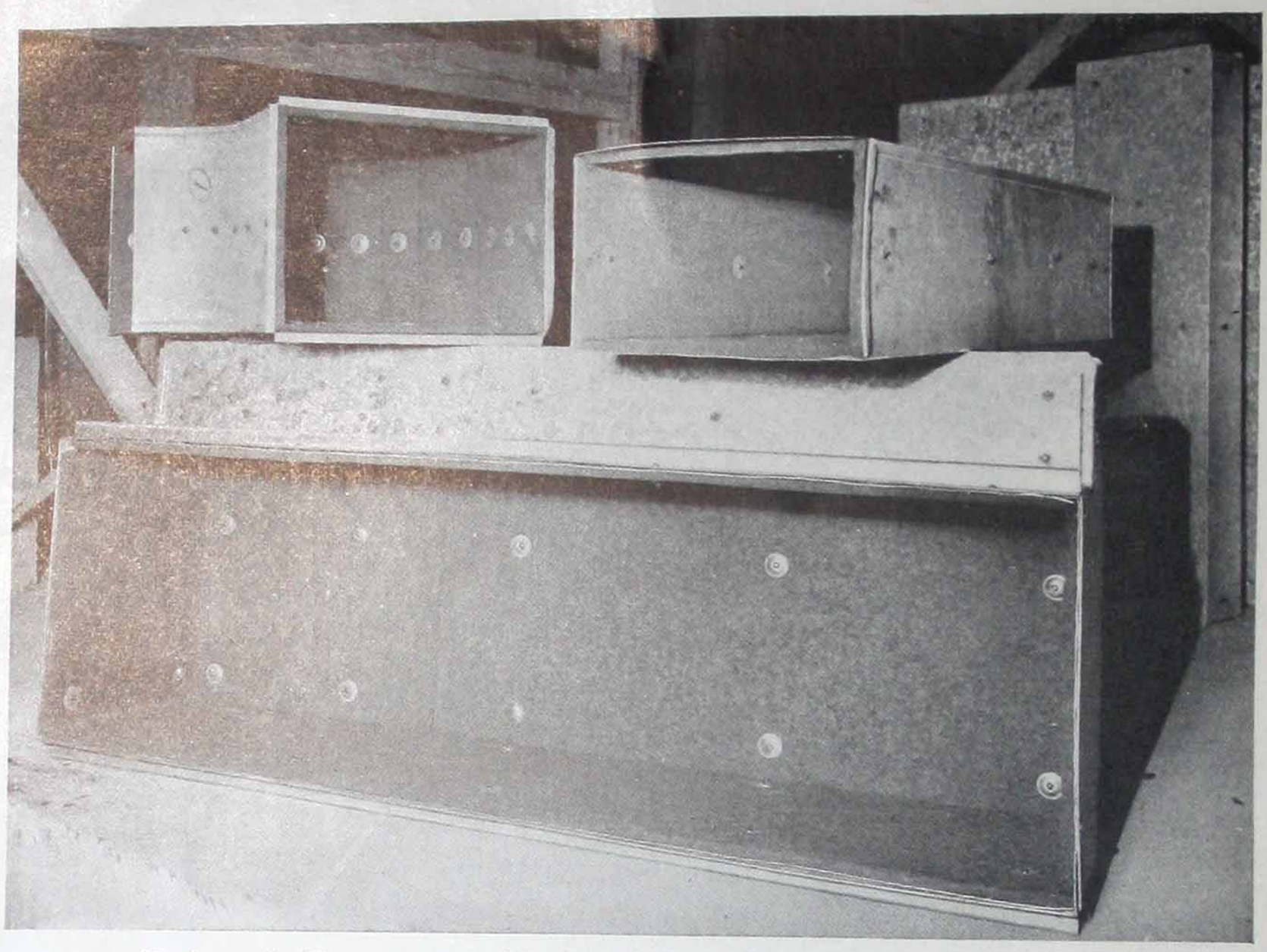

Air-Acoustic Sheets are readily installed in all types of sheet metal duct construction. Note how smoothly the material is fitted into a typical bend

principally one of absorbing air-borne sound. In the case of either vibration or air-borne sound, the purpose of sound control methods is to allow but a fraction of the original energy to remain for ultimate and inevitable transmission to other parts of the structure.

An important refinement to the above two main classifications of treatment consists in reducing sounding-board action of housings by applying suitable materials to induce a damping effect. The housing may act as a sounding board by re-creating as noise the vibrations resulting either from air-borne sounds or from direct structural contact. The damping effect of the treatment not only reduces the noise but changes its character and often eliminates objectionable tinny sounds frequently present with sheet metal casings.

Still another phenomenon, known as resonance, sometimes aggravates the difficulty of quieting mechanical equipment. Most often it is purely a matter of design to prevent sound originating in the mechanism from "building-up" and by subsequent repetitions, reinforcing the sound energy still undissipated. Where a change of design cannot be made to effectuate this purpose, resonance is attacked by applying materials to bring about selective frequency absorption or by changing volumes and inertias. Usually, the quieting methods referred to in the foregoing paragraphs will also rectify a resonant condition.

All of the noise problems arising in connection with mechanical equipment are susceptible of scientific analysis. In fact, when confronted by a new type of noise problem, this is the only satisfactory way in which it can be approached. Experimentation is expensive and guessing is futile. Seemingly simple noise problems are often complex and, to untangle the elements of trouble, noise must be measured and frequencies analyzed. However, once a given type of noise problem has been studied by scientific methods, experience will usually indicate the treatment necessary. Johns-Manville Acoustical Engineers are trained to make recommendations based on such experience.

Air-Conditioning Units and Duct Systems:

Quiet operation is a most important consideration with all air-conditioning systems. Mechanical design, however carefully executed, is seldom sufficient for reducing noise to a point acceptable to the consumer.

Self-contained units, serving only one or two rooms, should have the mechanical plant sound isolated from its housing, which should usually be constructed of metal panels lined with an efficient sound-absorbent, such as Air-Acoustic Sheets, or Sound Isolation Blankets. Where panel damping is required, rather than sound-absorption, Pre-Cemented Silento Felt should be used.

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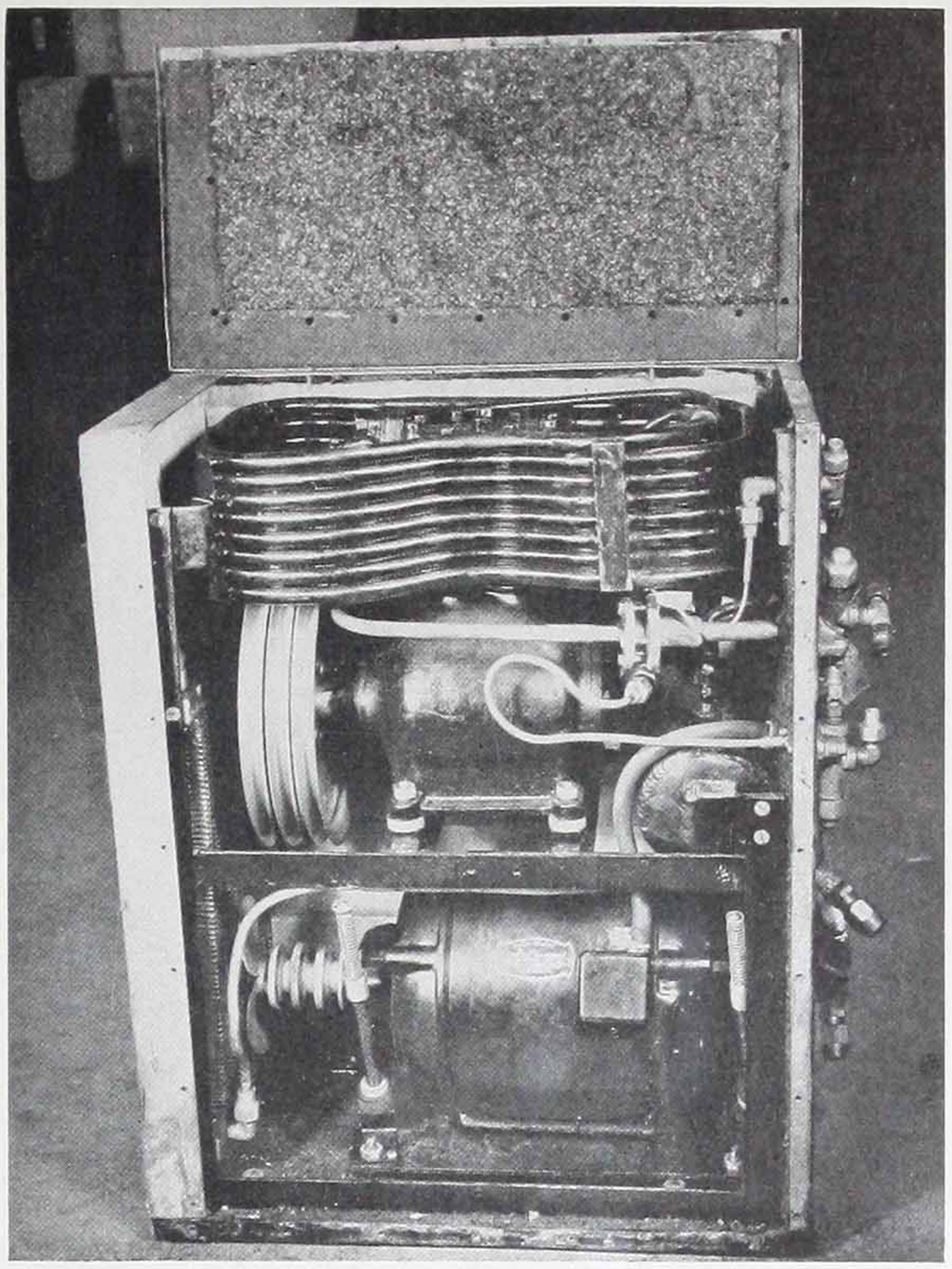
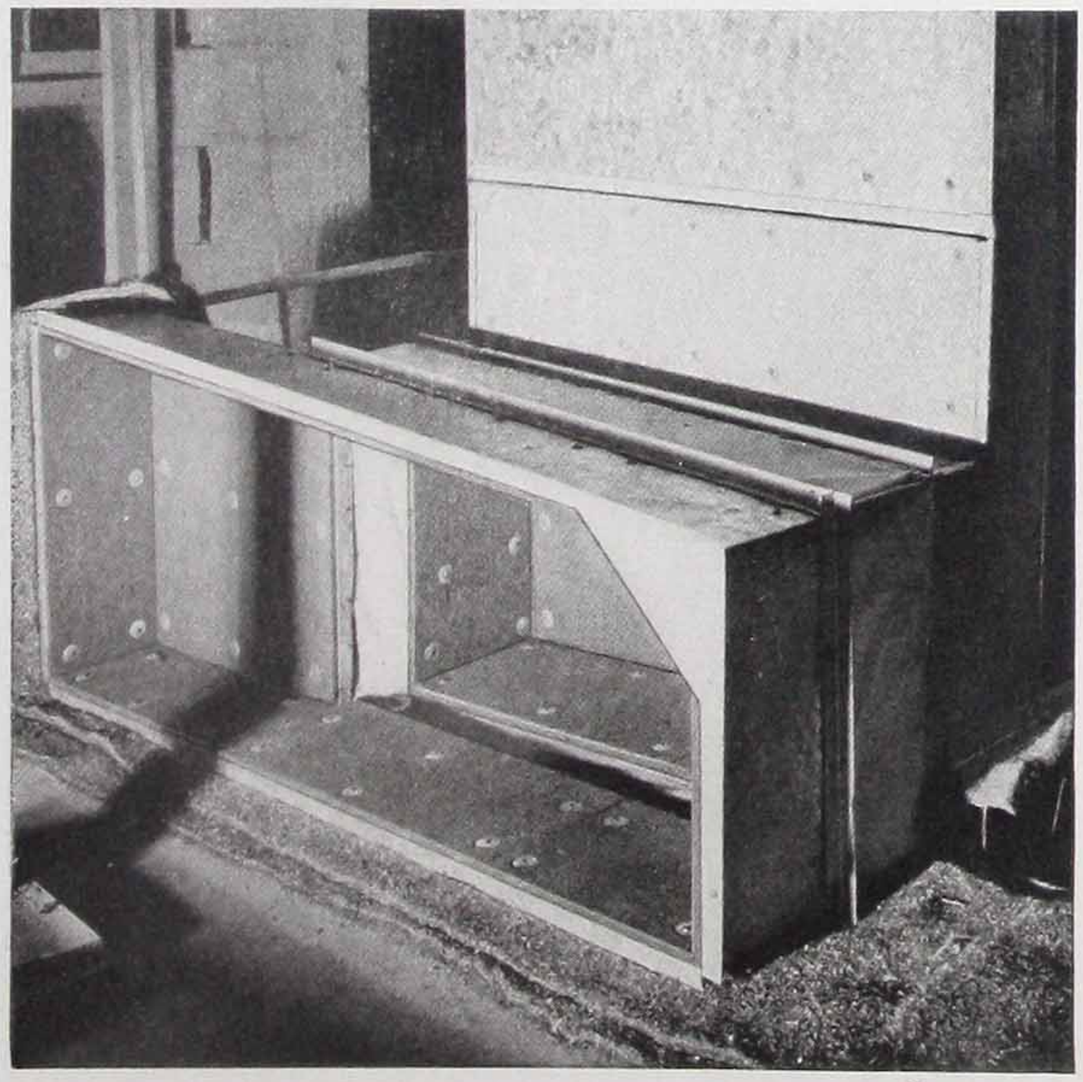
In larger systems serving an entire floor or building. the air-conditioning equipment should be located in a separate room which has been sound-isolated and treated with sound-absorbent material. The mechanical units should be separately mounted on vibration isolation platforms. It is essential that canvas or flexible connections be provided between the fan or blower units and the duct systems. Otherwise, the vibration of the fan and motor may be converted to sound by these ducts and transmitted by them to all parts of the building. It is also desirable that all piping be isolated from the duct system and from the building structure.

It is not enough to quiet and isolate the mechanical and power elements of an air-conditioning system because there is noise in the air stream which is accumulated as it passes through fans, washers and cooling coils. Acoustically, a duct is nothing more than a large-size "speaking tube" and sounds entering it at the equipment end are very effectively transmitted to whatever registers or grilles it supplies. When two or more rooms are served by the same duct it frequently happens that sounds created in one room are transmitted through the duct to the other rooms with a consequent loss of privacy. The solution to these problems lies in the use of efficient sound-absorbing linings within the ducts to remove and dissipate sound as it passes through them.



Compressor unit of room conditioner, sound-treated with Sound Isolation Blankets and Akoustikos Felt where precision cuts were necessary. Standard Air Conditioning, Inc., division of American Radiator & Standard Sanitary Corp.



Quietness is essential in operating sensitive broadcasting equipment. The entire duct system of WGN Studios (Chicago Tribune) was therefore lined with Air-Acoustic Sheets. Over 15,000 sq. ft. were specified for this purpose

In the entire field of sound control there is no type of service which places such exacting requirements as does duct lining on a sound-absorbing material. A satisfactory material must be fire-proof,* highly sound-absorbent, moisture-resistant, and have a surface which will not materially increase friction losses in the duct system. These requirements may seem rigid but Air-Acoustic Sheets, developed solely for this type of work, meet the specifications completely.

The necessary extent of the lining naturally depends upon the intensity of the noise. Generally speaking, however, a very appreciable and, in most cases, satisfactory reduction can be effected by lining a duct for a distance of at least ten times the average of its cross-sectional dimensions. Thus, a duct 8″ x 12″ should be lined for a distance of at least 8 ft. 4″. In severe cases the entire duct must be lined, regardless of di-

* In discussing the desirable properties of duct-lining materials, emphasis must be placed on fire resistance. Bulletin No. 10 of the National Board of Fire Underwriters, dated January 22, 1935, describes several serious fires in which the combustible materials used for the lining of ducts caught fire and caused extensive damage. As a result, the National Board of Fire Underwriters has taken the stand that only fire-resisting materials shall be used for such purposes.

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mensions and length. In cases where ducts are unavoidably short, a honeycomb arrangement of sound-absorbing partitions must be used to divide large ducts into a number of smaller ones.

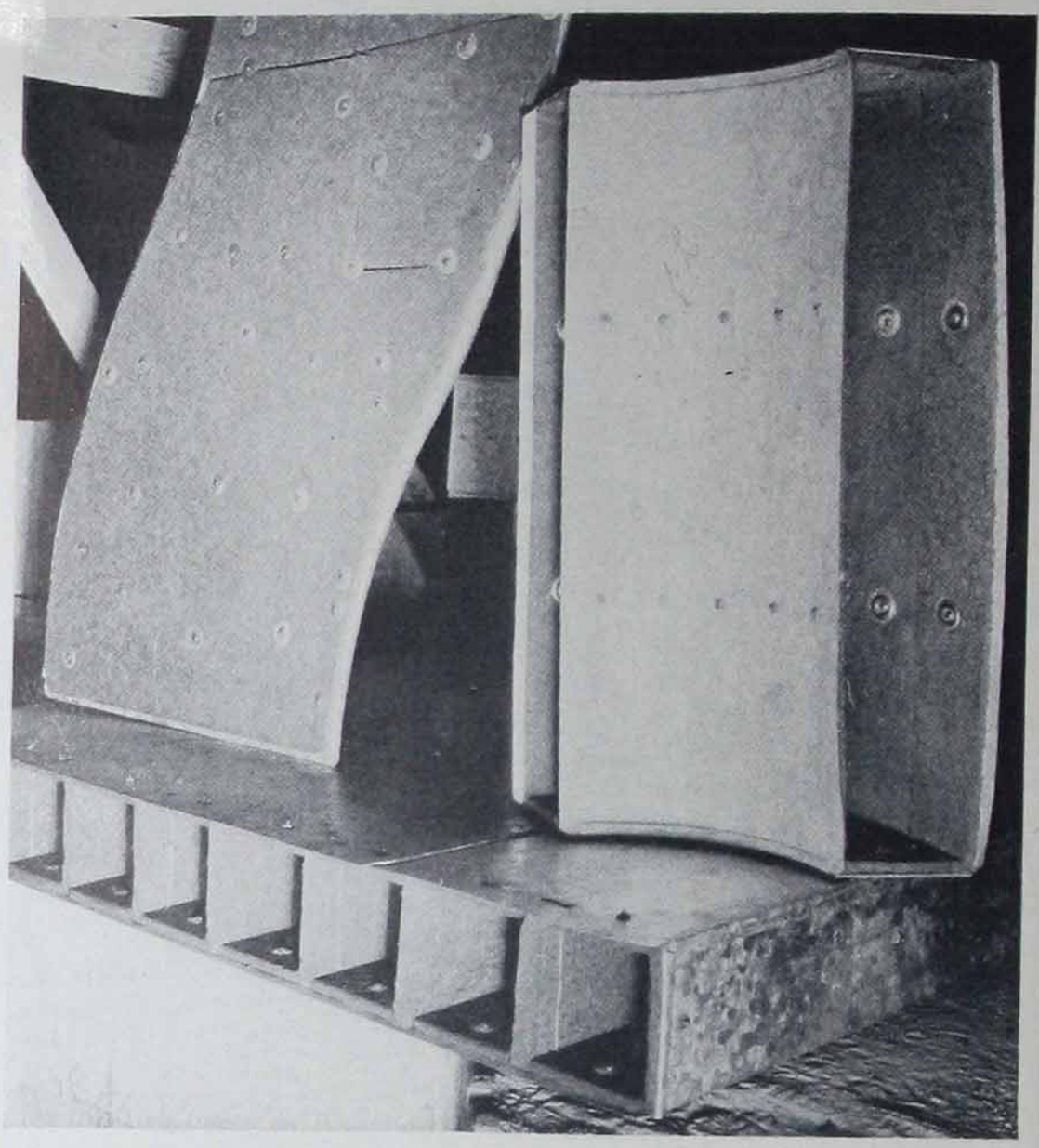
The ½″ thickness of Air-Acoustic Sheets is most economical to use except in cases where the additional low-frequency absorption and thermal insulation of the 1″ thickness are desirable.

Mechanical Refrigerators:

The manufacturers of such equipment as mechanical refrigerators usually provide an adequate vibration-isolating construction for the power unit. This leaves only the air-borne sound radiated from the machine, which could be largely confined within the cabinet except for openings necessary to provide ventilation for the motor and condenser.

These openings necessitate the reduction of noise level within the machine compartment, which is usually accomplished by applying efficient materials in the compartment to absorb noise near its source.

Air-Acoustic Sheets and Rock Wool Panels, Style



A duct, sub-divided by Air-Acoustic Sheets, for discharging air into the upper part of an auditorium. The ease of applying the Air-Acoustic material is illustrated in the sections shown above

Electrol oil burner and boiler, with No. 102 Banacoustic Blanket, 2″ thick, around the boiler and 1″ thickness elsewhere inside the housing. The insert shows the inside of the sound-treated access door

No. 2111, are ideally suited to this kind of application. Also, Silento Felt and Johns-Manville Wool Deadening Felt often are applied to the inside surface of machine compartments.

Oil Burners:

So far as noise control is concerned, oil burners are of two general types. One is the complete unit, comprising both burner and boiler; the other is a conversion burner intended for application to an existing heating plant.

In the latter case, the most that can be accomplished in the way of noise reduction is to quiet the oil-burning mechanism by enclosing it in a sheet metal housing lined with an efficient sound-absorbent such as No. 102 Banacoustic Blankets or Air-Acoustic Sheets. Where it is only necessary to damp the housing vibration, this is accomplished by applying Pre-Cemented Silento Felt. Stack mufflers help to reduce the roar of combustion on conversion installations. It is also very effective to lath and plaster an unfinished ceiling above the unit and treat the surface with 1″ thick No. 100 Banacoustic Blankets.

In the case of complete, self-contained oil burner and boiler, the combustion roar can be controlled along with the noises of a mechanical nature. Such

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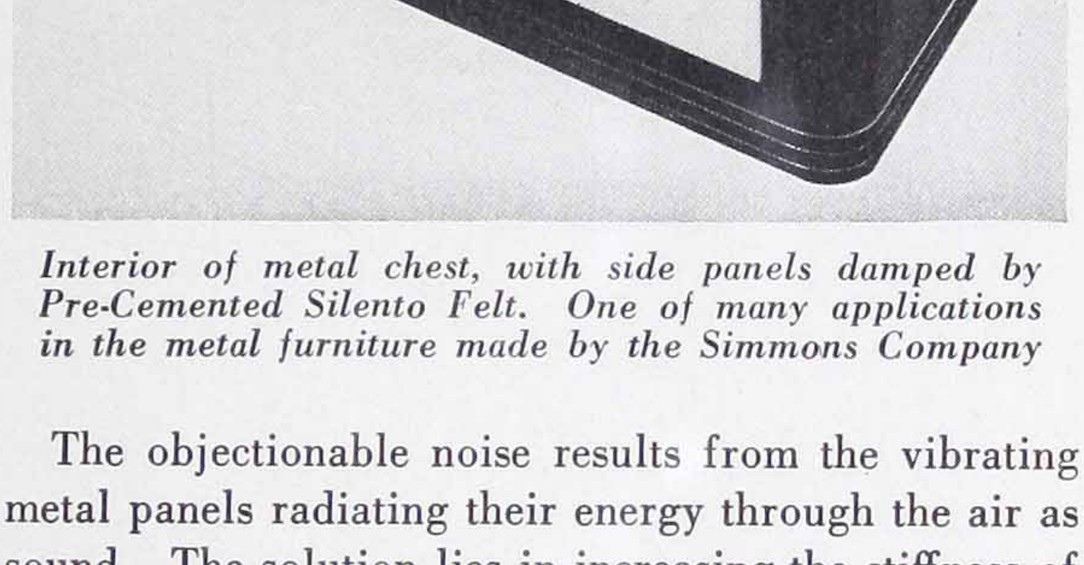
units usually consist of a specially designed boiler containing the oil-burning unit and enclosed in a sheet metal cabinet. The recommended noise-control procedure is to prevent the vibration of the boiler from being transmitted to housing or cabinet and to cover the boiler assembly and line the interior of the cabinet with No. 102 Banacoustic Blankets. The 1″ thickness is usually recommended, although 2″ Blankets are often used to provide additional thermal insulation. Stack and ceiling treatments effect further quieting.

Metal Furniture:

In keeping with modern tendencies, metal furniture and fixtures are gaining wide acceptance in the home as well as in the commercial field. The practical advantages of metal filing cabinets, desks and book cases are now paralleled by attractive and utilitarian kitchen cabinets, tables, ranges and living-room furniture.

An important factor, which has retarded the more general use of metal furniture, is the noise which it provokes. To appreciate the significance of this noise problem, one has merely to close a metal file drawer or accidentally touch a metal desk with a chair. This has aroused prejudice, which, however, is now being eliminated by treating the furniture itself.



Interior of metal chest, with side panels damped by Pre-Cemented Silento Felt. One of many applications in the metal furniture made by the Simmons Company

The objectionable noise results from the vibrating metal panels radiating their energy through the air as sound. The solution lies in increasing the stiffness of the metal panel, damping its amplitude, and lowering its natural frequency of vibration, thus reducing the efficiency of the panel as a transformer of vibration into sound. This is accomplished by applying Pre-Cemented Silento Felt, which is rolled on after receiving a brush coat of the solvent.

This doorless Acoustic Communication Booth, sold by Johns-Manville, provides free ventilation and comparative quiet

Other Equipment:

Many other types of mechanical units, not mentioned in the foregoing, generate noise in varying degrees of seriousness. These are constantly being analyzed in the Johns-Manville Acoustical Laboratories and the accumulated experience utilized by J-M Acoustical Engineers in the solution of noise problems.

Unusual appliances such as airplane detectors, together with more prosaic equipment, such as business machines, compressor cabinets, humidifiers, elevator cabs, metal sinks and automatic stokers, have been made the subject of research reports that made possible satisfactory reductions in sound level.

Splendid facilities enable Johns-Manville to solve noise problems, not only for conventional designs, but also in newly developed units for which there is no standard of comparison. Inquiries should be addressed to Johns-Manville, 22 East 40th St., New York.

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Sound Control Materials for Mechanical Equipment Quieting

Acoustical Cement, No. 130, an adhesive for cementing Asbestos Akoustikos Felt and sometimes for applying Sound Isolation Blankets to metallic housings, is supplied in 1, 3, 5 and 50-gal. containers. For Akoustikos Felt application, one gallon, with 40 percent added alcohol, will cover 100 sq. ft. of smooth plaster; with 1 gallon added alcohol, it will cover 200 sq. ft. of sheet metal.

Acoustical Cement, No. 132, is used for spot-cementing rigid tiles. Furnished in 1, 3 and 5-gal. containers. One gallon accommodates about 30 to 40 sq. ft. of tiles.

Acoustical Size is used to set the surface of Akoustikos Felt and to secure the finishing membrane of muslin. Furnished in 1, 5 and 50-gal. containers. For sizing, one gallon, with one gallon added water, will cover 200 sq. ft. For applying muslin, one gallon, with 40 percent added water, will cover 100 sq. ft.

Air-Acoustic Sheets are non-combustible, moisture-resistant sound-absorbents which are used chiefly inside air-conditioning units and ducts. Manufactured in rigid form from rock wool and a suitable binder. Net weight, 1½ lb. per sq. ft., 1″ thick. Furnished 24″ x 36″, in thicknesses of ½″, 1″ and 1½″.

Asbestos Akoustikos Felt, made of asbestos fibre and specially selected hair, is particularly desirable where a flexible sound absorbent is necessary. Supplied in rolls of approximately 160 sq. ft., in ¼″, ½″, ¾″ and 1″ thicknesses. Respective net weight per roll is 40 lb., 68 lb., 98 lb. and 128 lb. Rectangular-cut or die-cut shapes furnished on special order.

Banacoustic Blanket, No. 100, is a fireproof acoustical blanket manufactured from 1″ rock wool, faced on one side and all edges with flame-proofed muslin and secured between galvanized mesh and metal lath. Standard sizes are 2 ft. x 4 ft. and 2 ft. x 8 ft., weighing about 1.5 lb. per sq. ft., uncrated. This blanket is often used as a ceiling treatment above a noisy basement unit.

Banacoustic Blanket, No. 102, is made of long-fibre rock wool, felted between 1″ wire mesh. Furnished 2 ft. x 4 ft. and 2 ft. x 8 ft. in 1″, 1½″ and 2″ thicknesses. Available on special order faced with flame-proofed muslin under the wire mesh on one side and on all edges. Crated weight, approximately 1.5 lb. per sq. ft., 1″ thick. Used in preference to Sound Isolation Blankets where greater rigidity is required. Cut pieces supplied on special order.

Plastic Silento is used where Pre-Cemented Silento Felt cannot be applied due to irregularities of the surface to be treated. It is either sprayed or brushed on, and is used in thickness of approximately 1/16″. Furnished in 1, 5, 25 and 50-gal. containers. One gallon covers from 25 to 40 sq. ft.

Pre-Cemented Silento Felt. (See Silento Felt.)

Rock Wool Panels, Style No. 2111, are sound-absorbing units of long-fibre rock wool enclosed on the back and edges with chipboard and surfaced on the exposed side with wire fly-screening. Used in sound-treating small mechanical units such as refrigerators. Furnished ½″, ¾″ and 1″ thick in sizes up to 24″ x 42″. Minimum width, 6″; minimum area, 72 sq. in. Net weight approximately 1.3 lb. per sq. ft. for the 1″ thickness.

Silento Cement is used for attaching plain Silento Felt. Weighs about 12 lb. per gal. and is supplied in 1, 5 and 50-gal. containers. One gallon covers about 125 sq. ft.

Silento Felt (Pre-Cemented or plain) is a special asphalt-saturated product, approximately 1/16″ thick, used for damping vibrations in sheet metal. Sometimes also used in the machine compartment of mechanical refrigerators. Pre-Cemented Silento Felt is supplied with a factory applied coating which is rendered adhesive by using the proper solvent. In place, the felt will withstand temperatures to 300 deg. F., without bleeding or slipping, and may be painted or oven-dried as required. Both types of Silento Felt are furnished in rolls of 100 lin. ft., in widths of 24″, 32″ and 36″, and on order, in cut pieces. The approximate shipping weight of Pre-Cemented Silento Felt is 35 lb. per 100 sq. ft. Plain Silento Felt weighs about 25 lb. per 100 sq. ft.

Silento Solvents (standard and special) are volatile liquids which soften the cement coating on Pre-Cemented Silento Felt. The standard solvent is inflammable. The special solvent, not as efficient as the standard, is recommended only when the fire hazard must be minimized. One gal. covers 400 sq. ft. Supplied in 1, 5 and 50-gal. containers.

Sound Isolation Blankets (originally used in sound-isolating construction) often find application in lining air-conditioning units and oil burner housings. They are composed of ½″, 1″ and 2″ rock wool stitched between sheets of various materials: Type KA has flame-proofed kraft paper on one side and asbestos paper on the other; Type KK has flame-proofed kraft paper on both sides; Type MK has flame-proofed muslin on one side and flame-proofed kraft on the other; Type MM has flame-proofed muslin on both sides. Types KA and KK are furnished 36″ wide in rolls 65, 35 and 18 ft. long; the length of the roll decreases with increase in the thickness of the material. Types MK and MM are supplied in rolls of 22″ and 36″ and in thicknesses of ½″, 1″ and 2″. The ½″ and 1″ blankets are available in lengths of 50 ft. and the 2″ blanket in lengths of 25 ft. Net weight about 1.2 lb. per sq. ft., 1″ thick. Furnished in special sizes on order.

Wool Deadening Felt is used for damping vibrations in sheet metal when the material does not have to go through drying ovens or when greatest efficiency is not required. It is an unsaturated rag felt, made in three weights: ¾ lb., 1 lb., and 1½ lb. per sq. yd. Packed in rolls, 36″ wide, containing approximately 450 sq. ft. Respective weight per roll is 37½ lb., 50 lb. and 75 lb. Cut pieces supplied on special order.

Proper application of sound control materials is essential to secure maximum quieting efficiency. Johns-Manville Acoustical Engineers will be glad to offer advice as to approved methods which experience has shown to be most effective in accomplishing the desired result.

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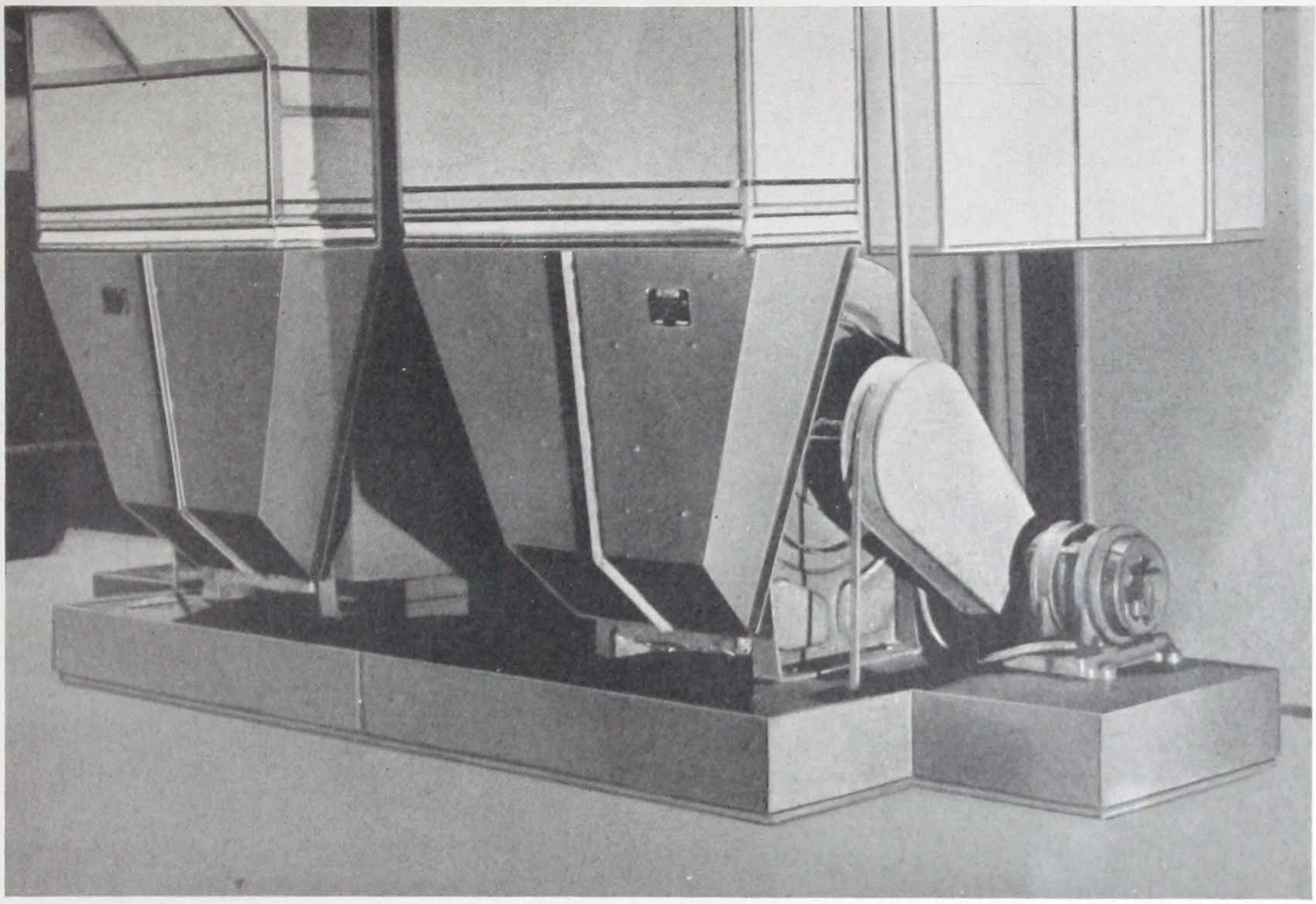
Anti-Vibration Platforms



A serious threat to the quality broadcasting of Station WWJ, Detroit, was the vibration created by the air-conditioning system. J-M engineers, however, confined these vibrations at their source by mounting the equipment on the specially designed A.V. Platform shown above

J-M Anti-Vibration Platforms are designed to isolate or divorce a vibrating mechanism from the building structure, in order to prevent the transmission of noise-producing vibrations. They make possible the allocation of machinery at points of economic advantage without creating an intolerable disturbance in adjoining parts of the building.

To isolate the vibration of all types of mechanical equipment, A.V. Platforms, made in a variety of designs, are specially fabricated to fit the needs of individual installations. Their general construction, however, consists of a platform top which is secured to the upper of two supporting tiers of stringers. The stringers, placed at right angles to each other, rest upon, and are separated by, heavily-felted, resilient chair sets. The spacing and the number of these sets are varied to accommodate load conditions. The types of chairs used are those that will best isolate the frequencies encountered.

A rock wool Sound Isolation Fill is placed between the stringers and partially fills the space between the floor and the platform top. An apron or skirting around the platform's base holds the fill in place.

Effectiveness

The effectiveness of Johns-Manville construction is illustrated by the comments of the late Professor J. L. Arnold, then Head of the Department of Electrical Engineering at New York University. In a letter from which the following is a quotation, he refers to an installation in the Electrical Engineering Laboratory as "giving great satisfaction."

"As you know, the building is of extra heavy steel construction and has thick concrete floors for supporting our machinery. Our 75 Kw. motor-generator set . . . was pronounced . . . to be commercially balanced, and it rested on a solid concrete foundation on the main floor of the building. In spite of these facts, it

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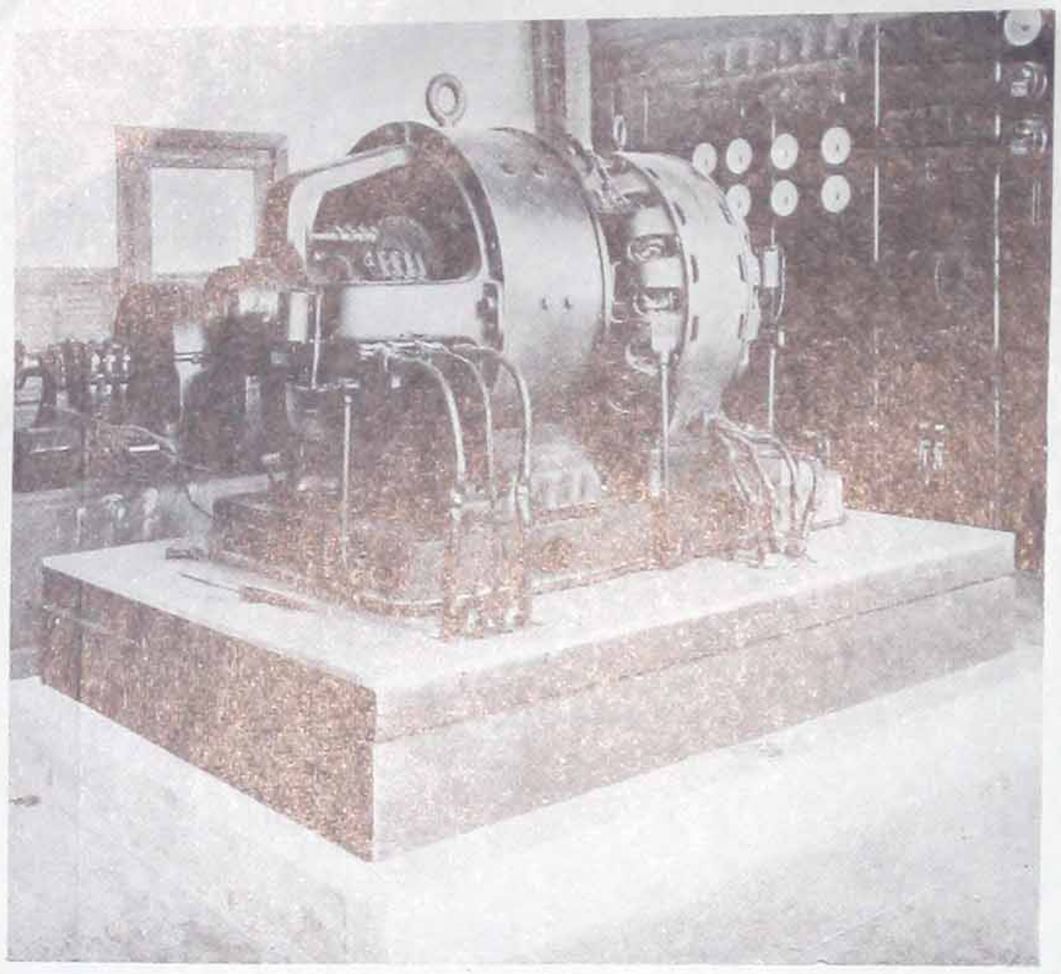


Motor-generator set, referred to in the text, mounted on a J-M Anti-Vibration Platform at the Electrical Engineering Laboratory of New York University

caused us great annoyance. The vibration was felt all over the building, even to the farthest corner of the upper floor. The adjustment of precision instruments was quite out of the question and even a hundred feet away our mechanic found difficulty in lining up machines. In our offices the noise was worse than distracting. Necessary as our set is to all departments of the College of Engineering as their main source of direct current, it had come to be regarded as a general nuisance.

"Then you installed your platform, and all complaint ceased at once. The machine continues to vibrate as much as ever, but its operation can scarcely be heard except, of course, in the laboratory itself. In order to test the perfection of your apparatus in damping the vibration, I placed a dish of clean mercury on the floor beside the machine and sighted across its surface toward the light. Not a ripple of disturbance was visible.

"We therefore pronounce your installation a complete success."

Platform Design

Different types of vibration-producing machinery, with the resultant variations of base size, loading, and vibration characteristics, necessitate the use of different types and spacings of chairs in order that the load per chair will not exceed its vibration-absorbing capacity. If the floor is light in weight or susceptible to relatively large deflections under load, the platform will not be as effective as when the supporting structure has greater weight and inertia. The platforms must be light in relation to the floor and building structure.

The factor of greatest importance in the design of a platform is that the load center of gravity of the equipment be directly over the center of resistance of the platform. The isolation fill generally used is eliminated when the platform is below grade. If platforms are subject to excessive moisture or constant dripping, creosoted wood should be used throughout or the platform top covered with sheet metal, or both, depending on the condition. For certain types of equipment or where fire restrictions require, concrete tops are used. All aprons are of sheet metal.

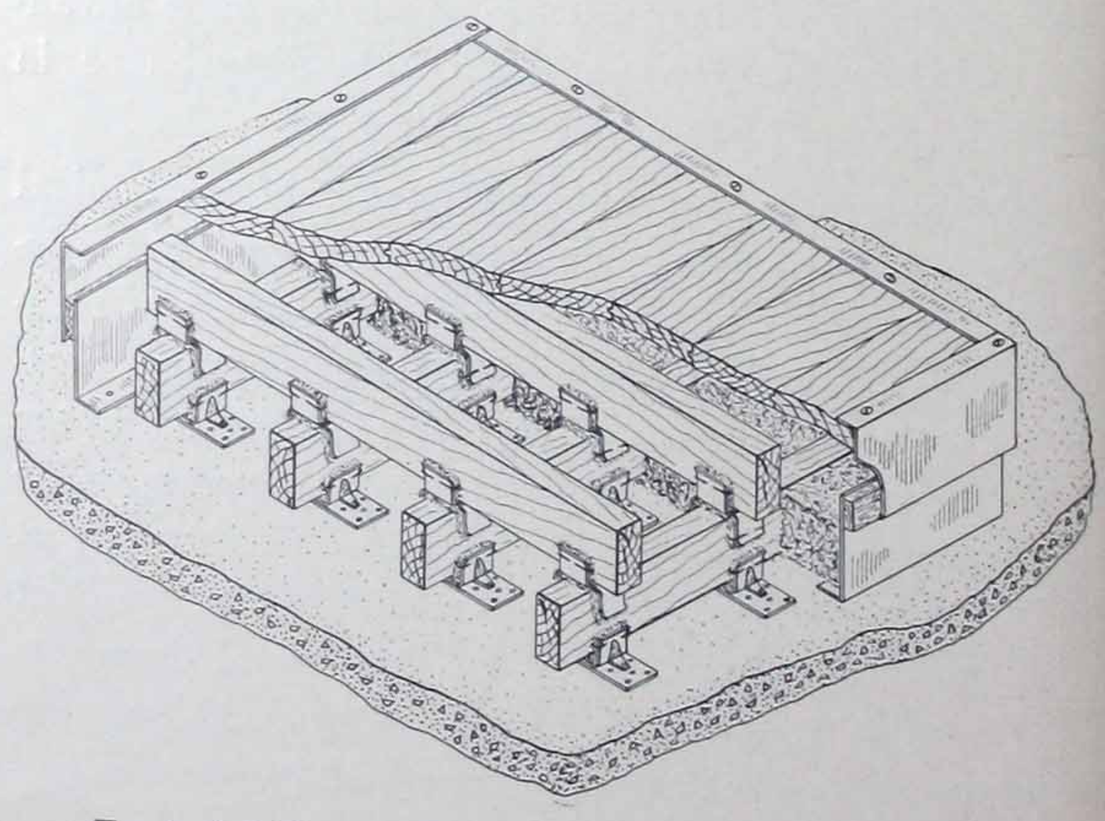
All pipes, ducts, conduit. etc., leading from the platform equipment, should be provided with flexible couplings or isolated from the structure to lessen the possibility of vibration transmission. All hose connections should be looped and installed vertically since straight hose couplings do not always isolate.

Where clearance is a limiting factor or where there are other special conditions, it is possible to support the vibrating units from the sides or hang the platforms from the ceiling or support them on wall brackets, if the load is not excessive.

In order to design a platform intelligently it is necessary to obtain the following information:

(1) Base sizes, spacing of equipment units with their respective weights, and location of load center of gravity.

(2) Description of the type of equipment, shape of platform, and the conditions to be met in the building.



Typical J-M Anti-Vibration Platform Construction

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INTERNATIONAL

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ELECTRICAL

TRANSITE

PACKINGS

REFRACTORY CEMENTS

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API INTERNATIONAL

CCA

Corrugated Transite

Laying J-M Corrugated Transite Roofing. The cut corner construction permits a tight joint with straight lap lines, and results in a durable, attractive roof

A material for industrial roofing and siding construction must, in addition to possessing structural ficiency, withstand the many forms of destructive ac- on which are common in chemical and metallurgical ocesses. For over twenty years Transite has con- nually proved its value as such a material, not only ecause of its durability and fire-resisting qualities it also because of its ease of application and free- om from painting or other maintenance.

Transite is made of asbestos fibre and portland ce- ent, formed under great pressure into dense, un- minated, monolithic sheets possessing unusual rength, rigidity and durability. Corrugated Tran- te sheets are designed for use as roofing, siding and artitioning, particularly over skeleton frame con- ruction. This material has been extensively used by ilroads, public utilities and industrial plants because its exceptionally high resistance to acid fumes, kaline vapors, adverse atmospheric conditions and xtreme and sudden temperature changes.

In the thousands of installations which have been ade, every detail of construction has been thoroughly worked out to assure rapid, economical erection. Special fasteners have been designed, accessories made available in the form of ridge rolls, corner rolls and louvres, and ventilators manufactured of Transite to meet a wide variety of requirements.

Characteristics of Transite

Resistance to Fire:

Transite, in addition to being non-combustible, will withstand considerable temperature without cracking or buckling. This resistance to destructive agencies, while desirable under all conditions, is essential where combustible products are manufactured. In the event of a fire in one of a closely related group of buildings, Transite prevents the destruction of the entire plant by confining the fire to its source. This is well illustrated by the large use of the material as a roofing over stills in oil refineries where it has proved effective in preventing the spread of fire from one unit to another. No other material, so adaptable to general building construction, surpasses Transite in resistance to fire.

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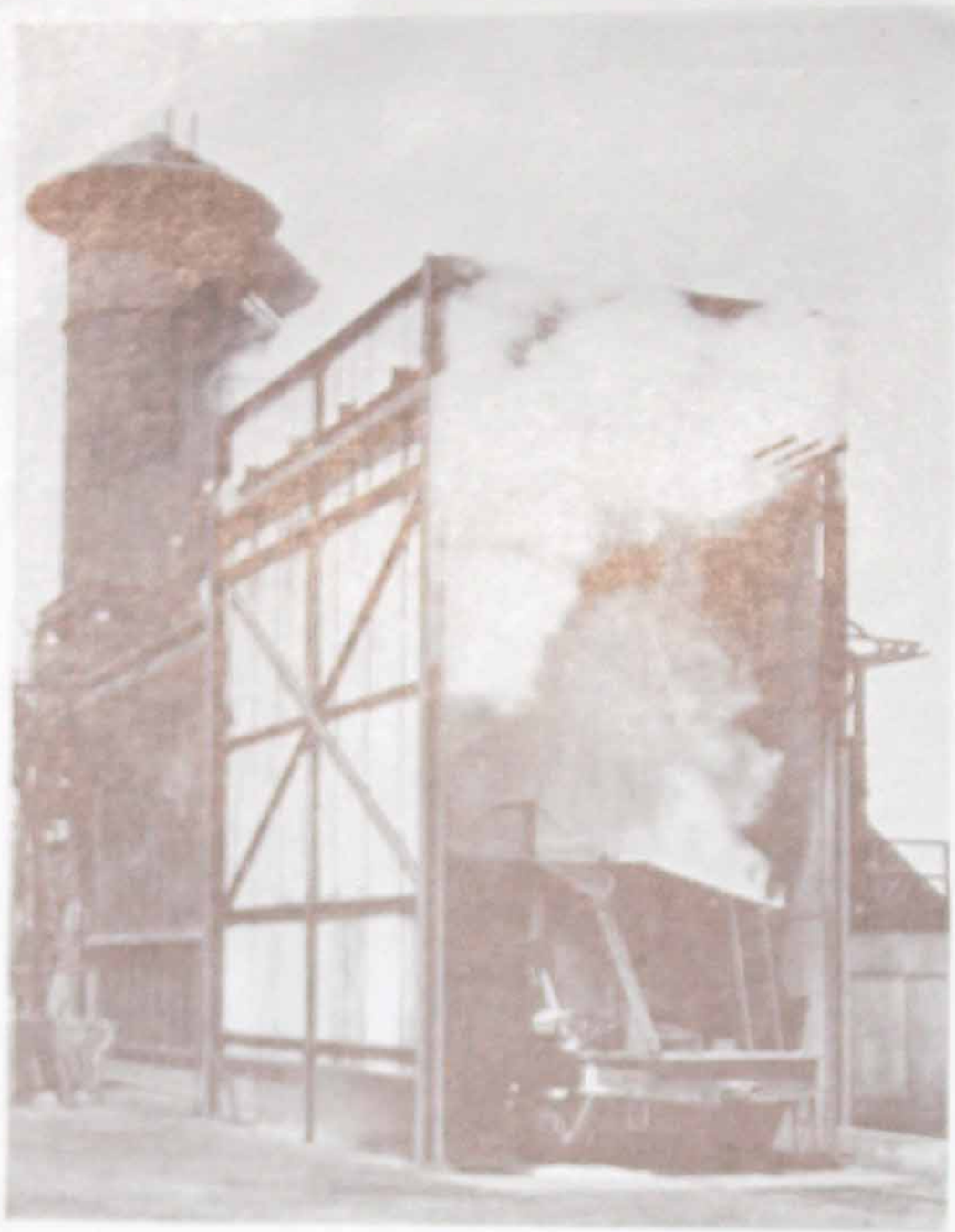

Transite used on a coke-quencher station

Resistance to Weather and Corrosion:

In chemical industries, Corrugated Transite roofing and siding provide resistance to the corrosive attacks of practically all the common acid fumes and gases, such as the vapors around gas plants, coke ovens, smelters and other metallurgical equipment. Where roofing and siding previously had to be replaced frequently, Transite has been in use for many years without the necessity for maintenance or replacement.

Similarly, the extremes of climatic conditions do not deteriorate Transite. Neither is it affected by rain and salt corrosion even where the atmosphere is heavily charged with chemical vapors and dust which is dissolved in the rain to form acid.

Resistance to Temperatures and Steam:

Alternate dry and wet conditions or high and low temperatures, common to many industrial operations, do not harm Corrugated Transite. It may be used over open vats, in boiler rooms and wherever steam, irrespective of its temperature or condition, is likely to come into contact with the roofing and siding.

The coke-quencher offers an outstanding example of this "shock-proof" quality. A car loaded with glowing coke, radiating heat at a temperature of about 1700 deg. F. against the Transite, is run into th quencher, and the cold water is turned on. Some o this water strikes the Transite, the rest hits the glow ing coke and is promptly converted into steam. Th steam strikes the water-cooled siding, and escapes t the atmosphere. This process is repeated in frequen cycles during the working day. Transite is the onl corrugated material which has satisfactorily withstoo the rigors of this unusual service.

Durability and Economy:

Like many other portland cement products, Tran site actually becomes tougher and stronger with ag and stands up for years under conditions which de stroy other forms of roofing and siding. Since it re quires no protective painting or other maintenanc expense and because it reduces fire risks to a mini mum, Corrugated Transite is decidedly economical Accurate records of users indicate that Transite as sures the longest life and lowest per annum cost.

Physical and Structural Properties:

Strength: The great pressures used in combining the asbestos fibre and portland cement, together with the reinforcing action of the asbestos fibres, produce a surprisingly strong sheet. However, while Transite possesses ample strength for the purpose intended, it should not be subjected to overloading or undue shocks. Workmen should use "chicken ladders" on

Transite is used on water-side coal handling equipment of this large East coast public utility

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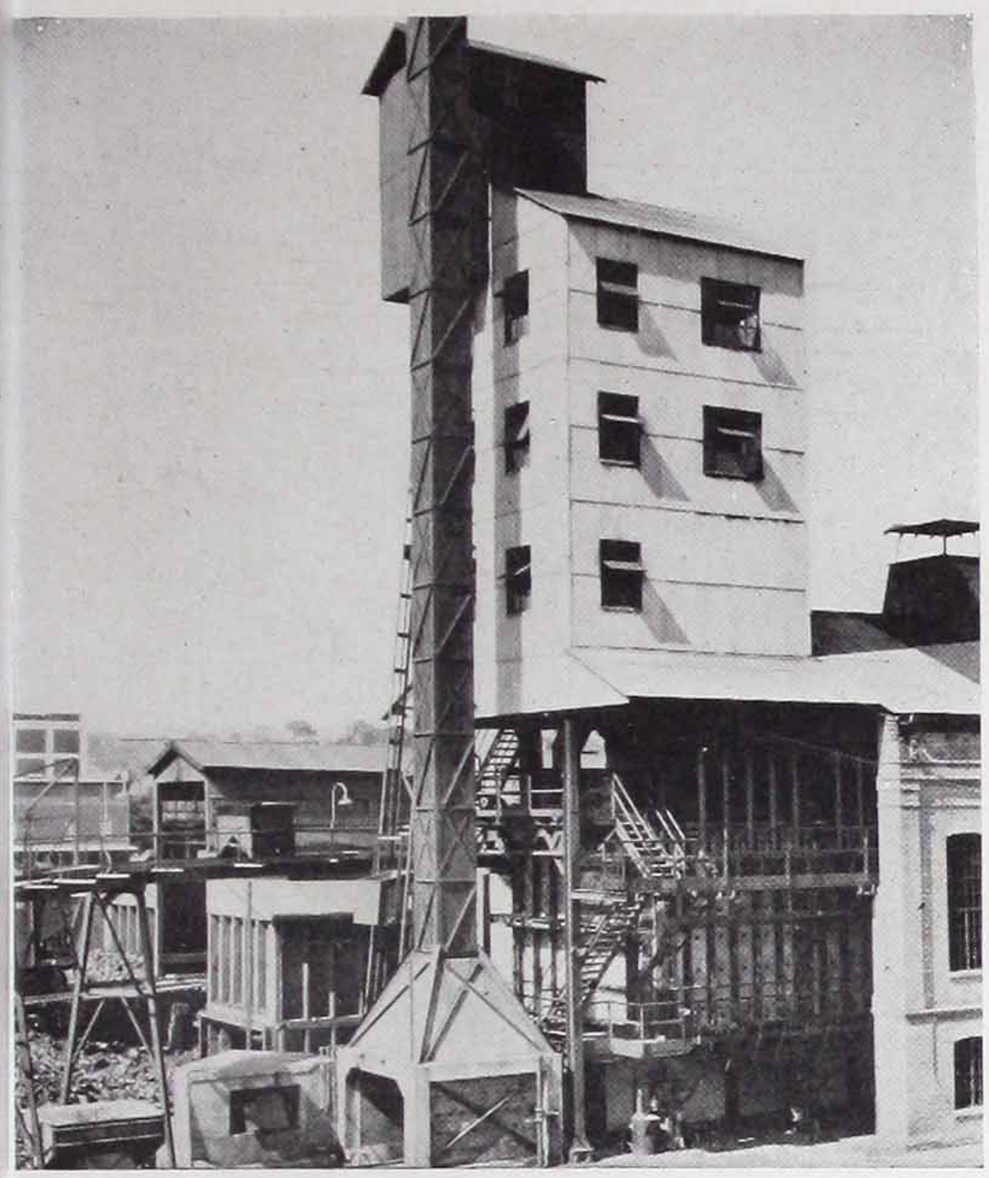


Corrugated Transite on U. G. I. Intermittent Ovens, Dubuque, Iowa

roofing work. For the standard Corrugated Transite sheets with 4.2″ pitch, the maximum spacing framing members for roofing is 54″ center to center; for siding, 66″ center to center.

Appearance: Transite, a light gray in color and uniform in texture, presents an attractive appearance. Its light-reflecting properties are often of advantage not only for interiors but also for exteriors in reflecting the heat of the sun. Transite can be painted if desired for architectural effect by first priming the clean and dry material with boiled linseed oil. Detailed directions for the special treatment of cement-asbestos products appear on another data sheet.

Ease of Application: Transite requires no special tools for application and it can be installed as rapidly, in the same general way, as any other corrugated material. The material can be drilled with twist drills, punched, fastened with nails and screws and sawed with a hand saw, though a portable power saw should be used if much sawing is to be done. Special fasteners, which are supplied on order, further facilitate erection over various types of framework.

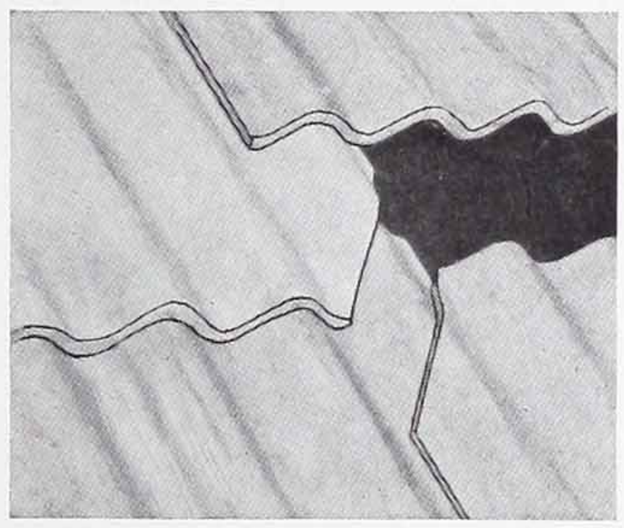
Perfect Nesting of Corrugations: An important feature of Corrugated Transite is the cut-corner construction of the sheets, shown on the drawings, which permits sheets to be laid with side laps forming straight lines. Furthermore, the inside and outside radii of the corrugations are the same, insuring perfect nesting at laps and a water-tight and wind-tight construction. If desired, the sheets can also be furnished with all corners square for staggered joint construction.

Where Corrugated Transite Is Used

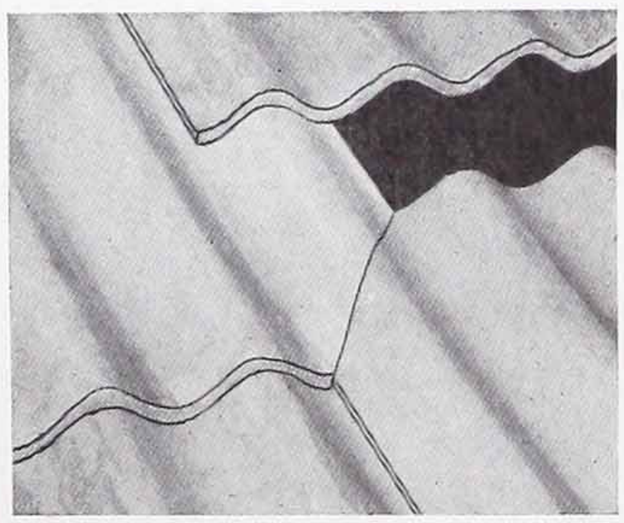
In the following brief outline, a few of the many interesting and widely varying applications of Corrugated Transite are reviewed.

Oil Refineries: Corrugated Transite serves for fireproof aprons and roofs over stills, housings of various types, and for "flare-back" walls around tanks to prevent spread of burning oil to adjacent tanks in case a fire develops.

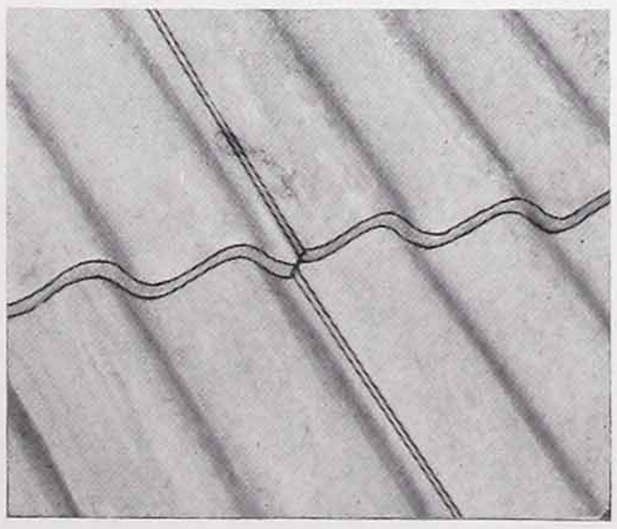
Railroads: Transite is used for switch towers, freight houses, way stations, and relay, battery and tool sheds, pedestrian overpasses, smoke baffles, round houses and car shops. Transite Smoke Jacks, Smoke Ducts and Ventilators, described on other data sheets, are widely used in round houses.



Sheets in position for closing joints



Underlying sheets with joints closed



Top sheet completes "perfect nesting"

Illustrating the effectiveness of the cut-corner construction in forming closed joints with straight lap lines

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A million and a half square feet of Corrugated Transite on the roof and sides of the International Harvester Co. plant at East Moline, Ill.

Chemical and Metallurgical Industries: For these industries Transite solves some of the most aggravating building problems, due to its resistance to the majority of commercial acid fumes. Whether used in gas and coke plants, electro-chemical industries, smelters, refineries, or in any other location, Transite affords continual protection. Where especially corrosive or humid conditions are encountered, W.R. Transite should be used. This product is impregnated with an acid-resisting compound.

Mines and Quarries: The material is applied as roofing and siding on hoist houses, loader and crusher sheds, storehouses and similar structures.

Coal Conveyor Housings: Transite housings are employed in many public utilities and industrial plants where large quantities of coal are handled.

Warehouses and Docks: Due to the unusual fire hazards, Transite is widely used.

Garages and Hangars: Fire resistance, light-reflection, easy erection, low cost and appearance are essential qualities fulfilled by Transite for garages, hangars, terminals and similar buildings.

Fair and Exposition Buildings: Transite is especially adapted to this type of construction, which is used only intermittently and represents a large investment, both in first cost and in re-conditioning. With Transite, erection costs are held to a minimum and maintenance costs are practically eliminated.

Corrugated and Flat Transite

Corrugated Transite is often used in combination with Flat Transite, especially for the smaller types of buildings, such as employees' houses, sheds, tool houses and similar structures. In such case, corrugated is used for roofing and flat material for siding. Battens, also made of Transite, are placed over the butt joints on the siding, providing an effective seal against wind and rain. Corrugated and Flat Transite are also used in combination for the building of cell structures in the electrical industry. Architects and decorators employ flat and corrugated sheets to work out unique, modern designs in stores and exhibits.

Employee Housing: Companies operating in locations which require the maintenance of employee housing facilities use Transite very effectively to produce economical, fire-resisting houses of attractive appearance. The possibility of practically complete salvage, when panel wall construction is used, increases the advantages of Transite for this type of building.

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Corrugated Transite Dimensions and Weights

Corrugated Transite sheets have corrugations with a 2″ pitch* and a depth of 1½″. The thickness is approximately 7/16″ at ridge and valley of corrugations d approximately 5/16″ on tangent, an average ickness of ⅜″. Sheets are furnished 42″, or ten rrugations, wide. Standard lengths and square foot eas of sheets are listed below:

Length	Sq. Ft. Area	Length	Sq. Ft. Area
3′0″	10.5	7′6″	26.25
3′6″	12.25	8′0″	28.0
4′0″	14.0	8′6″	29.75
4′6″	15.75	9′0″	31.50
5′0″	17.5	9′6″	33.25
5′6″	19.25	10′0″	35.0
6′0″	21.0	10′6″	36.75
6′6″	22.75	11′0″	38.50
7′0″	24.5		

Weights: Uncrated, approximately 4.1 lb. per sq. Crated, approximately 4.75 lb. per sq. ft. A small ldditional charge is made for crating.

Sized Sheets: The dimensions listed above are approximate. Sheets cut to accurate size can be furnished, required, at a slight extra charge for sizing. Unless herwise specified, standard sheets will be shipped.

Cut Sheets: Sheets can be furnished any desired idth or length that can be cut from standard sizes. ıch special size sheets will be charged for on the ısis of the next larger standard size. For example a eet 42″ wide and 6′ 3″ long would be billed on the ısis of a 42″ x 6′ 6″ sheet.

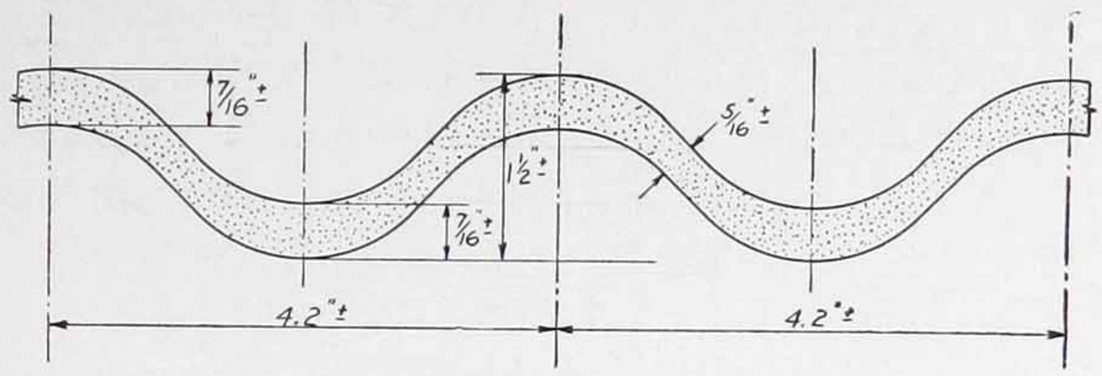
Curved Sheets: Curved sheets are manufactured order. The minimum radius when curved lengthise, with the arc parallel to the length of sheets, is)″. When curved crosswise, with the arc parallel to e width of sheets, the minimum radius is 24″. ıeets may be curved either way, but not lengthwise ıd crosswise together.

ut-Corner Construction:

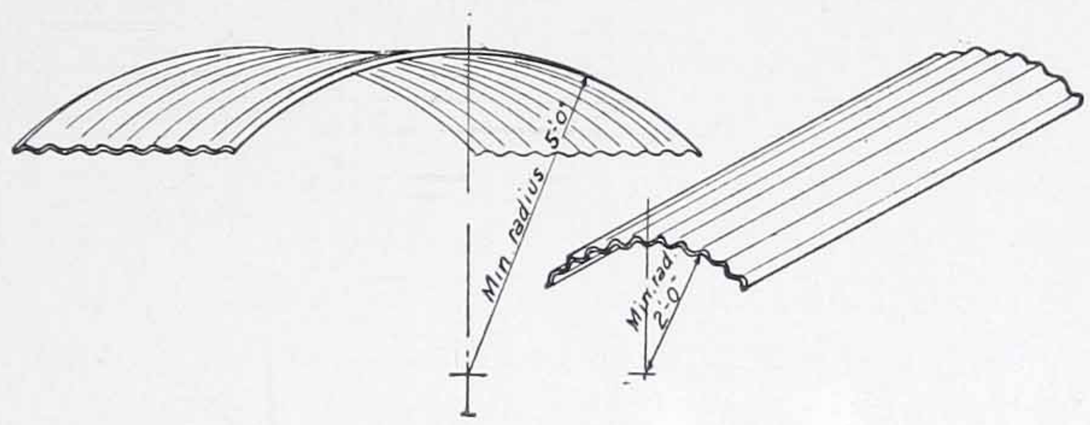
Corrugated Transite sheets are furnished in three pes: Type X with all corners square; Type Y with ıe corner cut; and Type Z with two diagonal corners ıt. These three types are shown in an accompanying lustration. The cut corners enable Transite to be id with straight horizontal and vertical lap lines hich further improve the appearance of the job.

If desired, the sheets can also be furnished with all ›rners square for staggered joint construction.

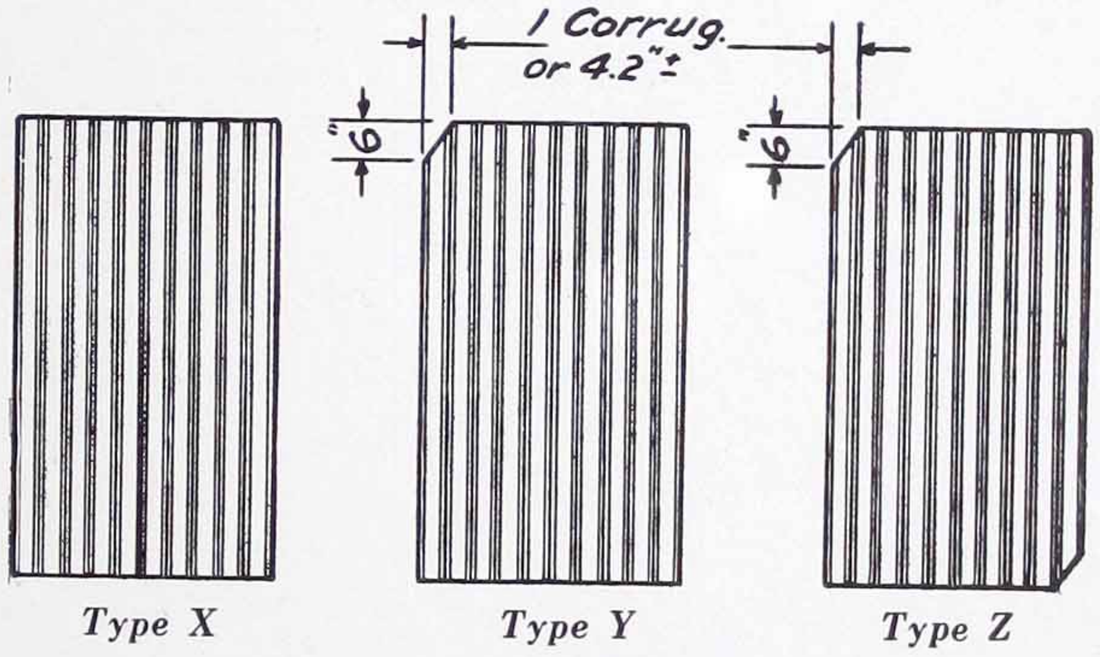
*Corrugated Transite also may be obtained with corrugations of ⅜″ pitch and 1 3/16″ depth, in 42″-wide sheets up to and including ft. 6″ long. Consult Johns-Manville regarding specifications and plication methods when 2⅝″ Transite is desired.



Corrugated Transite sheet dimensions



Curved Corrugated sheets



Type X *Type Y* *Type Z*

Types of cut-corner sheets

Accessories:

Transite is furnished pre-shaped as ridge and corner rolls and louvre blades. It is also furnished in flat sheets, as described elsewhere. Special Transite ventilators are also described in other data sheets.

J-M Black Asbestos Roof Putty is used for cementing laps of roofing sheets. The same putty, in gray, is used to cover exposed fasteners other than the lead-head type. This material is described in the "Roofing and Shingles" Section.

Corrosion-resisting bolts, Transfalt strips, drive-screws, washers and clips of various types have been designed especially for use with Corrugated Transite.

The special Corrugated Transite shapes and fasteners are shown in detail on another data sheet.

inted in U. S. A.

Erection:

Skilled labor is not needed for the proper erection of Corrugated Transite. Because of the convenient sheet sizes and the accessories available, this material can be speedily applied by the average workman.

As with any other corrugated material, Transite should not be laid on roofs having a pitch of less than 2″ per foot. J-M Black Asbestos Roof Putty should be used in all laps of roofing sheets. The same putty, in gray, is used to cover all exposed fasteners other than the lead-head type.

Corrugated Transite should be laid with a side lap of one corrugation, 4.2″, to give a weather exposure of approximately 37.8″. End laps should always be specified 6″, and should occur over purlins or girts. Purlins should not be spaced on greater than 54″ centers, and side-girts on centers not greater than 66″. This applies to standard 4.2″ pitch sheets.

Complete directions for the erection of Corrugated Transite are available in other data sheets.

W. R. Corrugated Transite

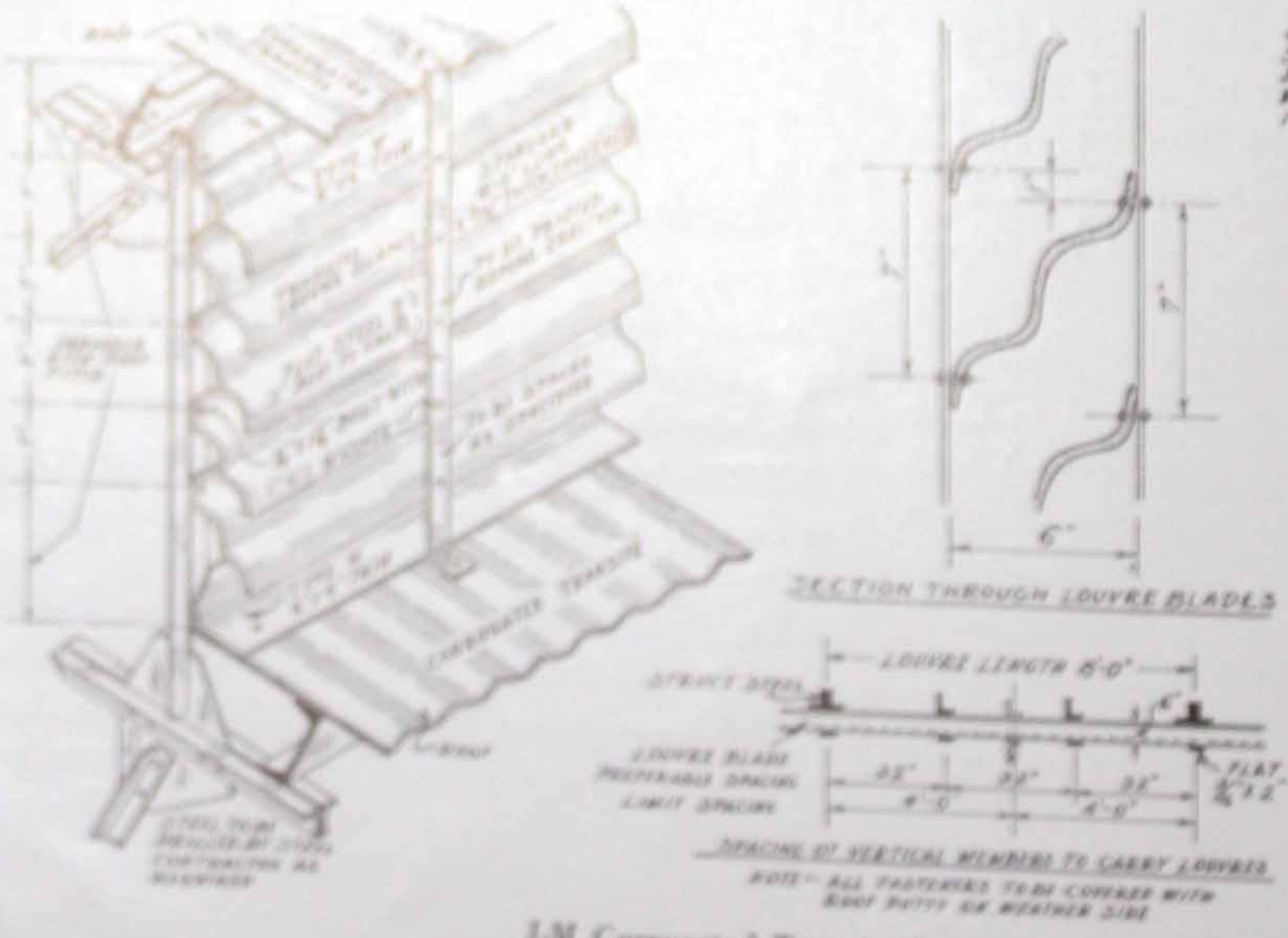
Corrugated Transite sheets can also be furnished with a special bituminous impregnation to afford maximum impermeability. The impregnated product, called W. R. Transite, is used to great advantage where the material will be subjected to extreme and sustained moisture or acid conditions. W. R. Transite is also available in flat sheets.

The durability of W. R. Transite makes it an id deck for the J-M Insulated Rot-proof Roof which especially designed to withstand the severe conditi encountered over the machine room in paper m and in similar industrial building roofs. The sulated Rot-proof Roof consists of cork mastic, co board (or approved alternate) and a J-M Asbes Built-up Roof, all laid over the W. R. Transite de

W. R. Corrugated Transite is furnished in the sa sizes as standard Corrugated Transite in lengths up and including 8′ 6″. Sized, cut or curved sheets c be supplied as described for the standard materi Ridge rolls, corner rolls and louvre blades are al available in the same design as standard Transite.

The weight of W. R. Corrugated Transite is a proximately 4.2 lb. per sq. ft. uncrated; or abo 4.85 lb. per sq. ft. crated.

In the erection of W. R. Transite particular ca should be exercised in the selection of fasteners th will withstand the conditions to be encountere Double-thick clips with bolts not less than ⅜″ diar eter, made of black iron, are recommended. All clip bolts, washers and nuts should first be cleaned an heated and then dipped in asphalt while hot. An abraded portions of fasteners should be touched u with asphalt or bituminous paint after erection. Whe sheets are cut in the field all unimpregnated edge should also be coated. Other erection details are th same as for standard Corrugated Transite.



J-M Corrugated Transite Louvre Blade details

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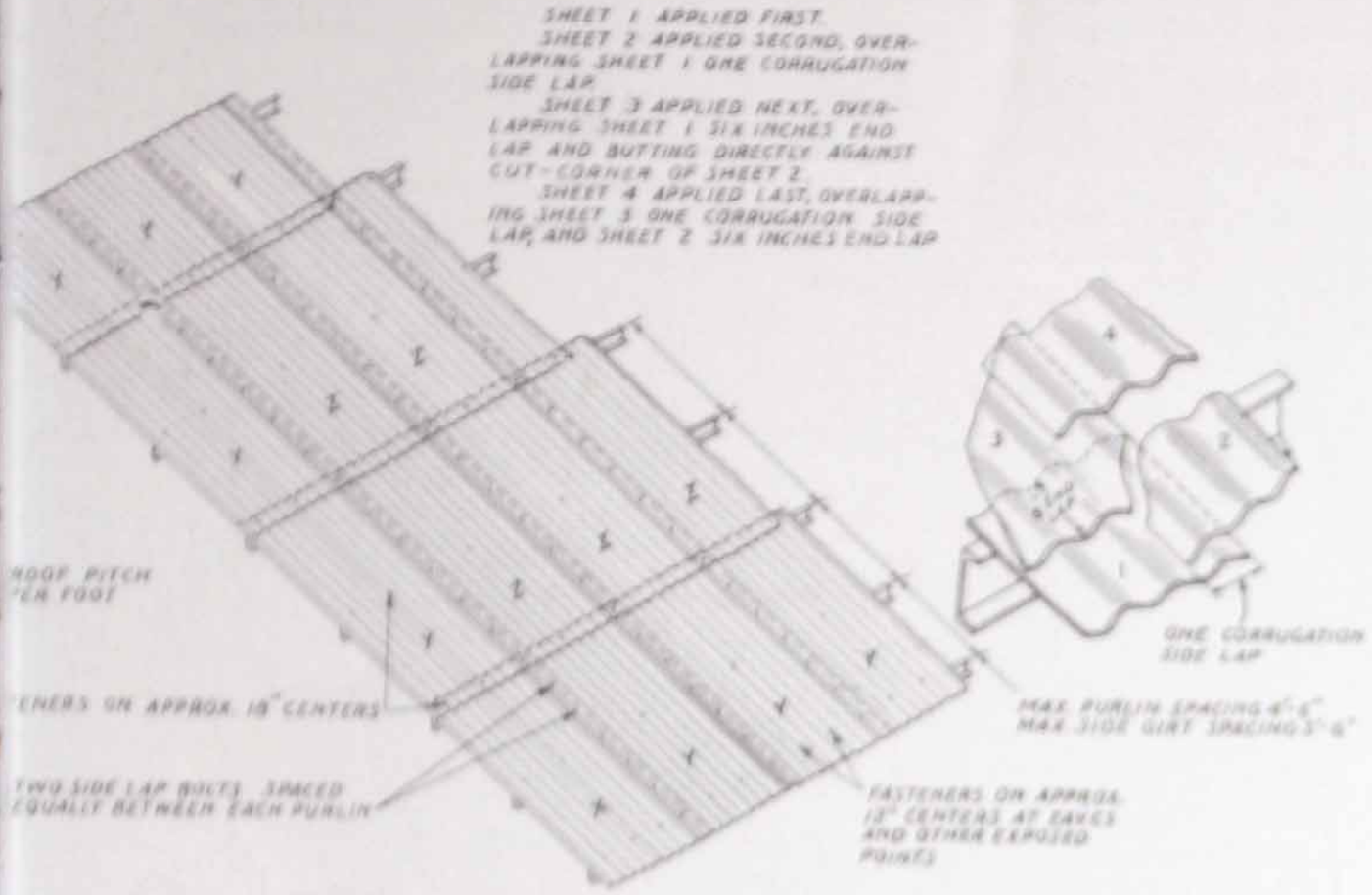
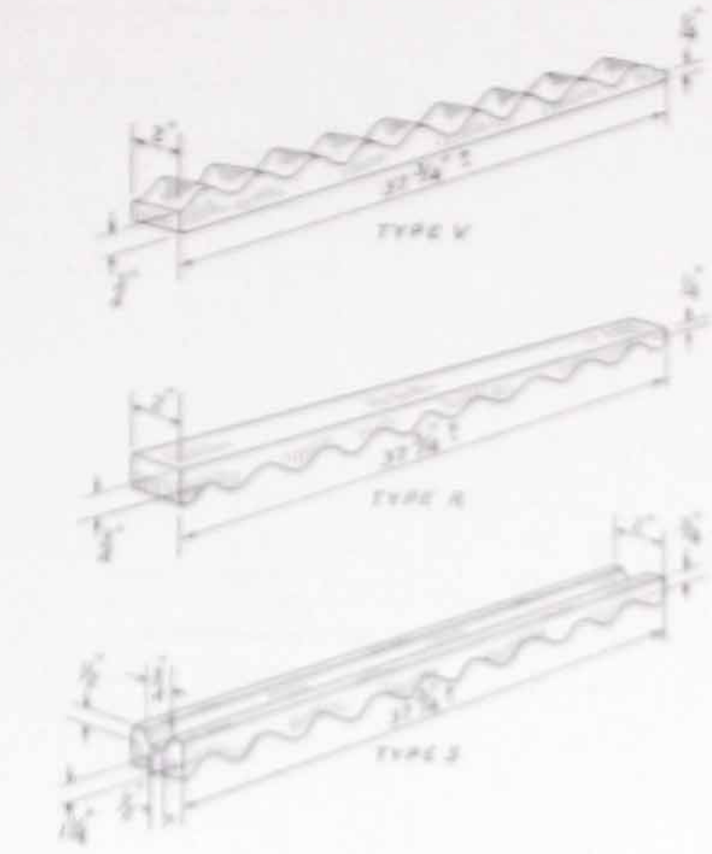
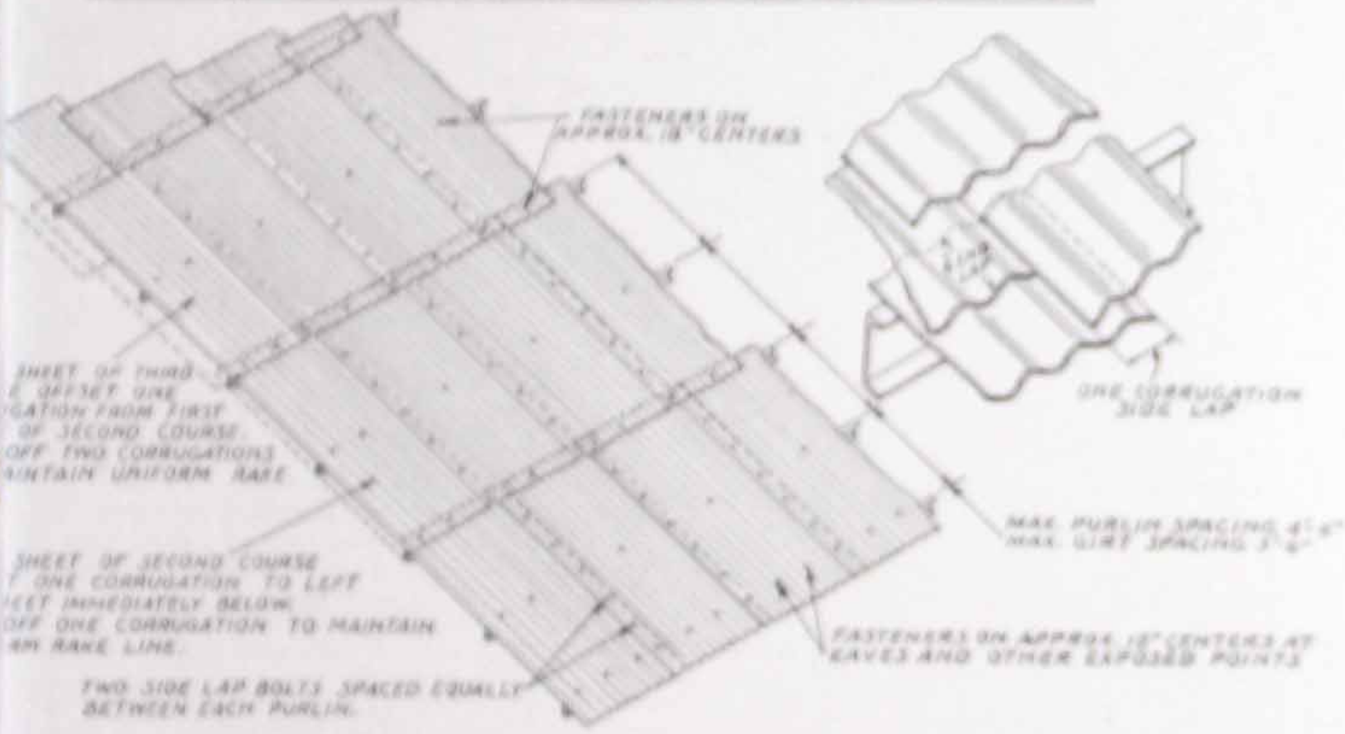
Construction details for 4.2″ Corrugated Transite



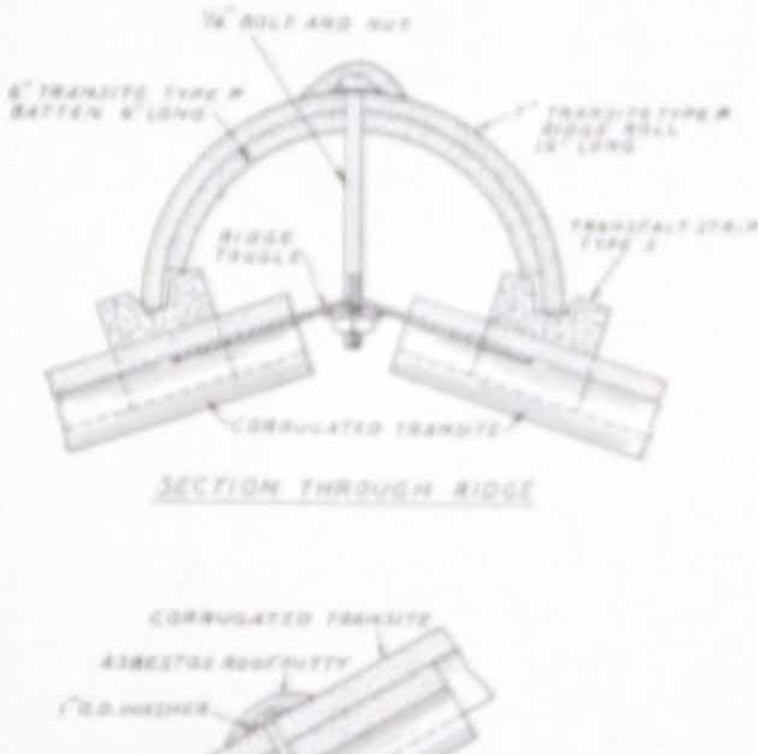
STRAIGHT LAP LINE CONSTRUCTION WITH CUT-CORNER SHEETS



TRANSFALT STRIPS

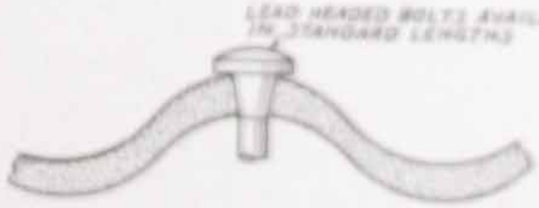


STAGGERED JOINT CONSTRUCTION WITH SQUARE-CORNER SHEETS

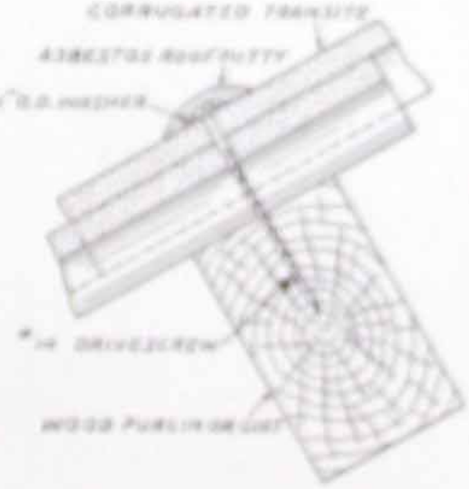


SECTION THROUGH RIDGE

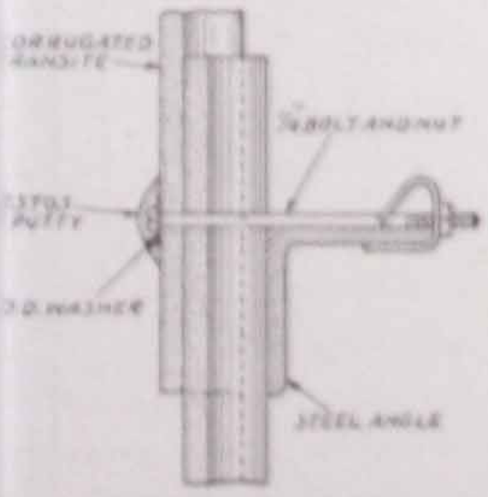
FCTION SHOWING CORNER ROLL



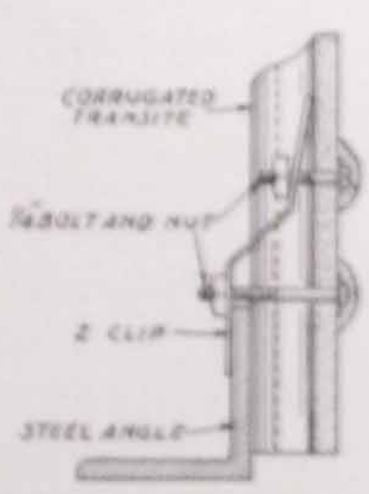
ALTERNATE TYPE FASTENER BOLT



DETAIL OF DRIVESCREW

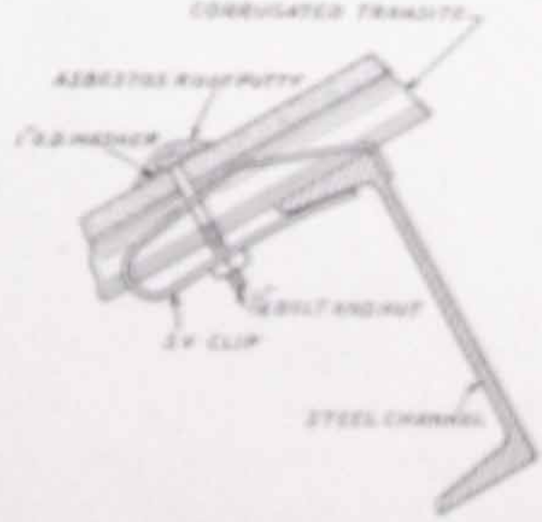


DETAIL OF HOOK CLIP



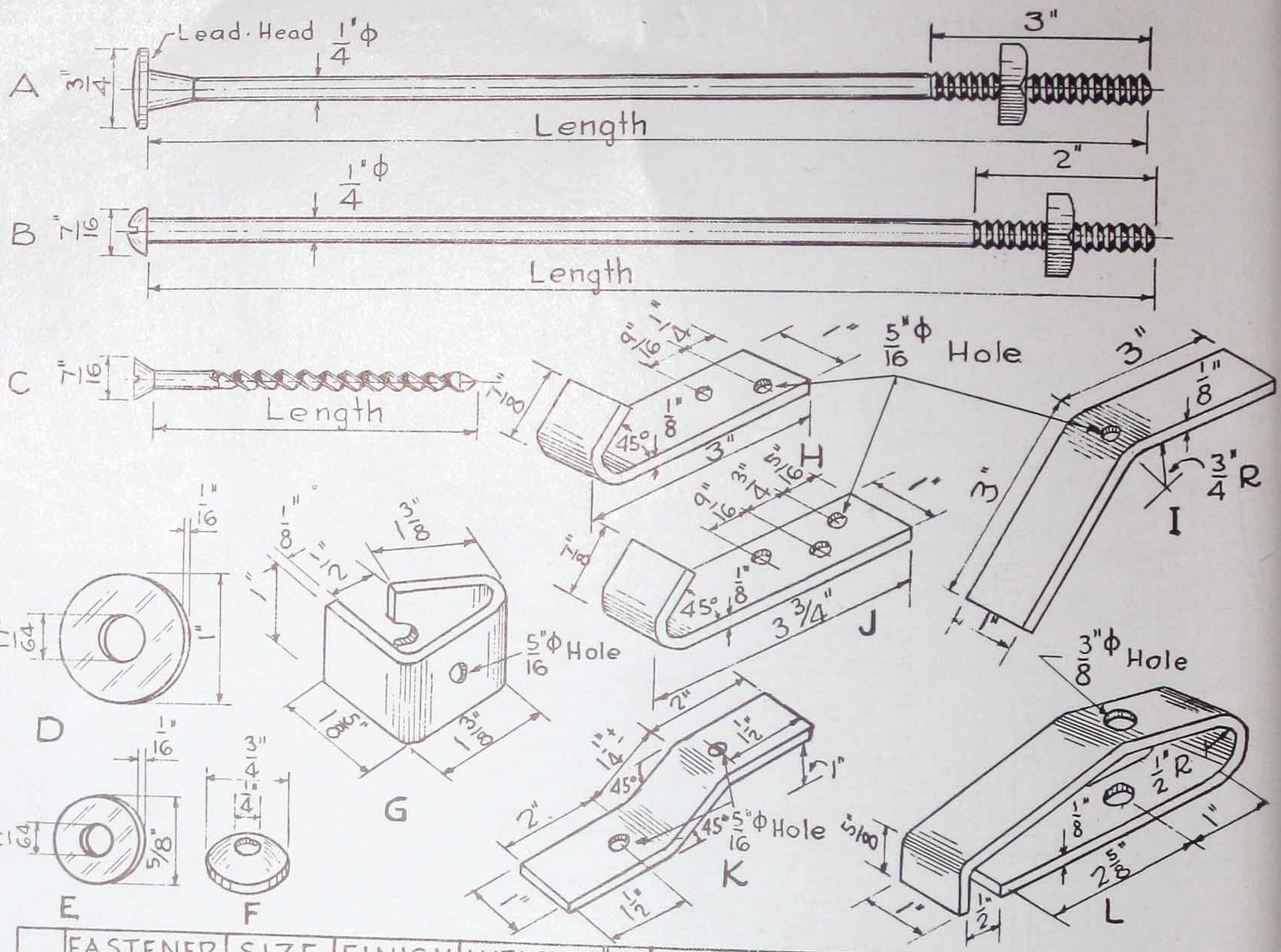
DETAIL OF Z CLIP

DETAIL OF J CLIP



DETAIL OF 3V CLIP

Patents No. 1,489,474, 2,015,129 and 2,021,929 Patented Canada 1925



	FASTENER	SIZE	FINISH	WEIGHT
A	LEAD HEAD BOLTS	1/4" X 2"	CADMIUM PLATED	18 PER#
"	"	" 3"	"	15 "
"	"	" 4"	"	13 "
"	"	" 5"	"	11 1/2 "
"	"	" 6"	"	10 "
"	"	" 7"	"	9 "
"	"	" 8"	"	8 1/2 "
"	"	" 9"	"	8 "
"	"	" 10"	"	7 "
"	"	" 11"	"	7 "
"	"	" 12"	"	6 1/2 "
B	ROUND HEAD BOLTS	1/4" X 1 1/4"	"	54 "
"	"	" 1 1/2"	"	48 "
"	"	" 1 3/4"	"	44 "
"	"	" 2"	"	39 "
"	"	" 2 1/2"	"	33 "
"	"	" 3"	"	28 "
"	"	" 3 1/2"	"	24 1/2 "
"	"	" 4"	"	21 1/2 "
"	"	" 4 1/2"	"	20 "
"	"	" 5"	"	18 "
"	"	" 5 1/2"	"	16 "
"	"	" 6"	"	15 "
"	"	" 6 1/2"	"	14 "
"	"	" 7"	"	13 "

	FASTENER	SIZE	FINISH	WEIGHT
B	ROUND HEAD BOLTS	1/4" X 7 1/2"	CADMIUM PLATED	12 PER#
"	"	" 8"	"	11 "
"	"	" 8 1/2"	"	10 1/4 "
"	"	" 9"	"	10 "
"	"	" 9 1/2"	"	9 1/2 "
"	"	" 10"	"	9 "
"	"	" 10 1/2"	"	8 1/2 "
"	"	" 11"	"	8 1/4 "
"	"	" 11 1/2"	"	8 "
"	"	" 12"	"	7 1/2 "
"	"	" 12 1/2"	"	7 "
C	DRIVESCREWS	#14 - 4	"	28 "
"	"	#14 - 3	"	33 "
D	WASHERS	1" O.D. X 9/32"	GALV.	74 "
E	"	5/8" O.D. X 7/32"	"	225 "
F	"	3/4" O.D. X 1/4"	LEAD (CUPPED)	77 "
G	HOOK CLIP		GALV.	7 "
H	J CLIP - 2 HOLE		"	7 1/2 "
J	J CLIP 3 HOLE		"	6 "
I	TOGGLE		"	4 3/4 "
K	Z CLIP		"	5 1/2 "
L	S-V CLIP		"	3 "

Corrugated Transite Fasteners

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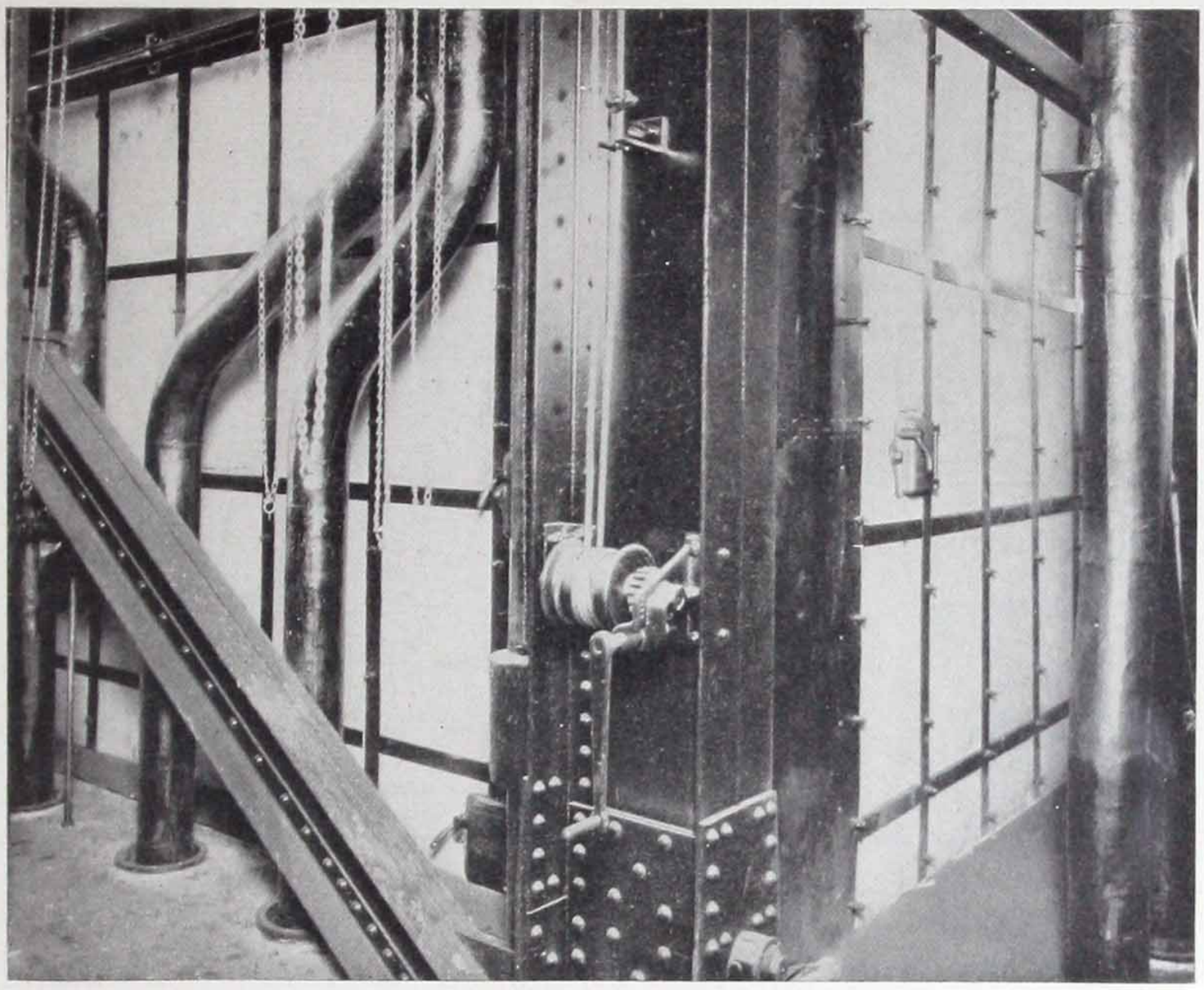
Flat Transite Asbestos Sheets



Transite casing over insulation on boiler water-wall

Transite is generally recognized as the outstanding
e- and corrosion-resisting building sheet on the
rket today. It is composed of asbestos fibre and
rtland cement, united under tremendous pressure
o dense, monolithic sheets of remarkable strength,
idity and durability.

Transite is light gray in color, and has a specific
avity of about 2.0, weighing approximately 124 lb.
r cu. ft. It can be drilled with twist drills, punched,
tened with nails and screws and sawed with a hand
w (set 5 points to the inch). A portable power
w should be used if much sawing is to be done in
field. For shop practice, see other data sheets.

Transite does not become warped, distorted or
akened in service; in fact, it actually strengthens
d toughens with age. It offers high resistance to acid
mes and severe weather conditions. It has with-
od severe fire tests and is widely used where re-
tance to fire is important. Painting, finishing or
otection against deterioration is never required.

Flat Transite is exactly the same material as Cor-
gated Transite, except for form. It is suitable for
e under constant temperatures up to 600 or 700 deg.
and much higher temperatures of short duration.
The characteristics of Transite are gone into in greater detail in connection with the description of the corrugated material on other data sheets.

Finishes:

Standard Transite is sufficiently smooth for practically all purposes, and thickness, to and including 2″, is controlled within plus/minus 1/32″. Material can be furnished, however, sanded on one side (S-1-S) or on two sides (S-2-S) to provide special smoothness and thickness control within plus/minus 1/64″. In thickness from 2½″ to 4″, the manufacturing tolerance is plus/minus 1/16″ in either standard or sanded finish. Unless otherwise specified, standard material is always furnished.

Painting and Cleaning:

If Transite is to be painted, it should first be primed with a coat of linseed oil. Pencil marks on Transite can be removed with art gum or sand paper. Black grease is washed off with a solution of sodium carbonate and the Transite sanded while still wet. Rust stain can be cleaned with oxalic acid or a 5% solution of phosphoric acid. If bloom stains appear on the Transite, a weak solution of phosphoric or hydro-

Flat Transite half-timber effects on residence in Detroit, Mich.

chloric acid will take them off. White or red lead should first be scraped off and the oil stain taken out with caustic soda. Then the Transite should be sanded while still wet.

Where Flat Transite Is Used

Because of its strength, resistance to both fire and corrosion, weatherproof qualities, comparatively light weight, attractive appearance and durability, the applications of Transite are practically unlimited. It finds a wide use in thousands of industrial plants as well as in hospitals, libraries, office buildings, railway stations, machine shops, garages and residences.

General Industrial Uses:

In all types of industrial plants, Flat Transite is used for walls, ceilings and partitions. Its easy workability and the speed with which the large units can be erected are important advantages. Transite is also used in industrial plants for housing of various types and for ducts, bins, table and bench tops and many other uses requiring a durable sheet material.

Furnace Casings:

It is an ideal material for casings over insulation on furnaces, boilers, tanks and other heated equipment. The 3/8" thick material is recommended, particularly on the larger types of equipment and where removable panel construction is required. Its relatively light weight and low thermal conductivity, compared with the steel casings otherwise used, and its corrosion-resistance, attractiveness and light-reflecting features combine to make Transite a highly satisfactory material for this purpose.

Residential Construction:

Transite is equally well adapted to interior and exterior use. Fire-resisting walls, ceilings and partitions, etc., for various types of construction, can be readily made of this material.

It lends itself particularly well to half-timber effects and for the construction of summer cottages and bath houses. Such construction is stronger than cement stucco applied over wire lath and will not crack, scale or erode. It can be readily applied directly over wood or steel studding by the same carpenters used for the balance of the work. Vertical and horizontal joints are covered with battens of the same material, of the width and thickness desired. Battens can be painted as required for architectural effects.

Flat Transite is also used in combination with Corrugated Transite for the complete construction of skeleton-frame buildings. This type of curtain wall construction is easily erected, fire-resistant, durable, attractive and economical.

Printed in U. S. A.

Flat Transite Sizes, Weights and Types

lat Transite is furnished as shown in the following e of nominal sheet sizes and thicknesses:

Nominal sheet size, inches	Thickness, inches
36 x 48	1/8 to 4
42 x 48	1/8 to 4
42 x 96	1/8 to 2
48 x 48	1/8 to 2
48 x 96	3/16 to 2

ncut sheets run somewhat full in length and width. en cut to another size, Flat Transite is furnished a tolerance of plus or minus 1/32″ of specified gth and width. Material cut to a closer tolerance supplied only on special order. Sheets can be led and countersunk at the factory, if required.

Thickness, Weights and List Prices (Uncut Sheets)

kness, hes	Approximate weights in lb. per sq. ft.* Uncrated Standard	Uncrated S-1-S	Crated Standard	Crated S-1-S	List prices per sq. ft.
8	1.7	1.4	1.8	1.5	$0.20
16	2.1	2.0	2.3	2.1	.25
4	2.8	2.6	3.0	2.8	.30
16	3.4	3.3	3.7	3.5	.35
8	4.0	3.9	4.4	4.2	.40
2	5.3	4.7	5.8	5.0	.50
8	6.9	6.7	7.5	7.2	.60
4	7.6	7.5	8.4	8.2	.70
8	8.9	8.7	9.7	9.4	.85
	10.1	9.9	11.0	10.7	1.00
4	13.0	12.8	14.0	13.8	1.25
2	15.7	14.0	17.6	15.2	1.50
4	18.5	16.8	20.6	18.3	1.75
	21.0	19.6	23.1	21.2	2.00
2	26	25	28	27	2.50
	31	30	34	33	3.00
2	36	36	39	38	3.50
	42	40	45	43	4.00

hese are actual weights of material and should be used for com- g dead weight loads, but not for figuring price or freight.

ransite is also furnished in corrugated sheets approximately 3/8″ thick, 42″ wide and in lengths of m 3 ft. to 11 ft. Corrugated Transite is fully debed in other data sheets.

Maximum Allowable Spans of Flat Transite

Thickness, inches	Ceiling, inches	Wall, inches
1/4	24	36
5/16	32	39
3/8	36	42
1/2	42	48
5/8	45	54
3/4	49	60
1	54	72

lat Transite sheets may be curved or moulded, in nufacture, to suit requirements. The sheets may be

Standard Oil Co. filling station, Cleveland, O., sided with Flat Transite

curved in any one direction, with a minimum radius of 5″. Special sections of ridge and trim can also be furnished. Transite is also moulded into ducts, smoke jackets, etc., as described in other data sheets.

W. R. Flat Transite

Flat Transite sheets can be furnished with a special bituminous impregnation to afford maximum impermeability where the material will be subjected to extreme and sustained moisture or acid conditions.

W. R. Flat Transite is furnished in standard size sheets, 42″ x 48″, 1/8″, 3/16″ and 1/4″ thick; 42″ x 96″, 1/4″ thick; and 36″ x 48″, 1/8″ and 3/16″ thick. Thicknesses greater than 1/4″ can be furnished on special order. The weight of W. R. Flat Transite, 1/4″ thick, is approximately 3 lb. per sq. ft. uncrated; or about 3.3 lb. per sq. ft. crated.

Black Transite

Black Transite is similar to standard Transite except for color. Used as a base for blackboards. No. 1 Finish is standard and No. 2 Finish is sanded. This material is made in standard flat sheets 42″ x 96″ and in thicknesses of 3/16″ and 1/4″.

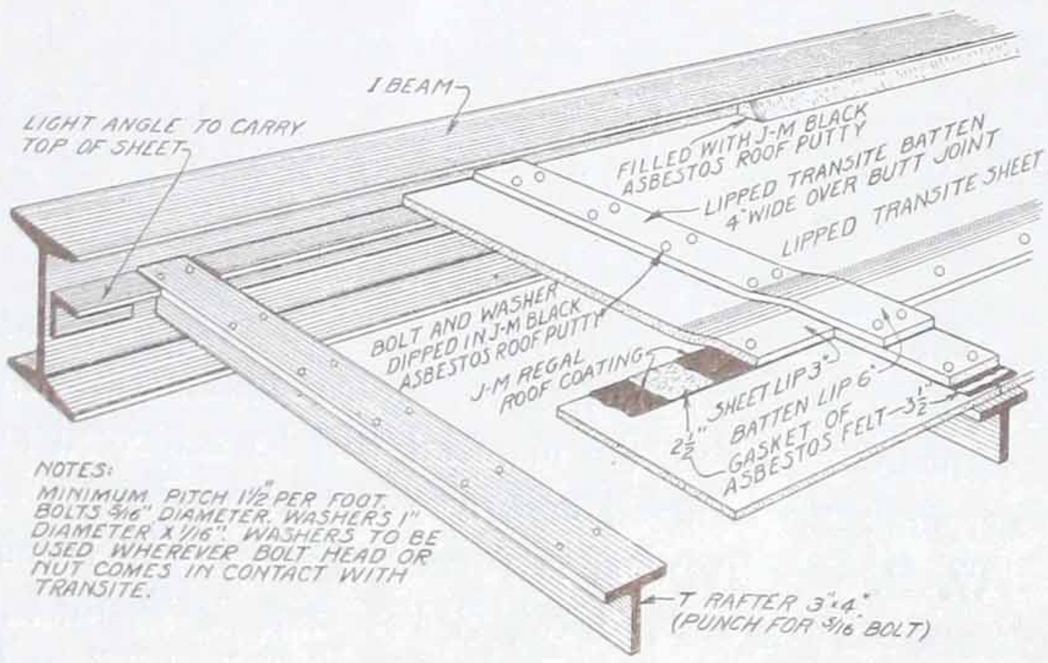
White Transite

A special White Transite can be furnished on order in standard size flat sheets with either standard or sanded finish. This material is especially adapted to use for exteriors of bake ovens and for similar applications where an attractive appearance is desired.

Lipped Flat Transite

Flat Transite can be furnished in special lip construction for use where a roof of flat, instead of corrugated, material is desired. This product is formed with a 3″ wide lip along one side or end, the lip being offset the thickness of the sheet so as to overlap snugly the adjoining sheet. In ordering, the location of the lips should be specified. The material is furnished 42″ x 96″ and either 5/16″ or 7/16″ thick.

Lipped Flat Transite may be applied over either wood or steel rafters. The maximum allowable span for 5/16″ thick material is 32″, and for 7/16″ material, 36″. For fastening over wood, either bronze or galvanized screws and washers should be used. Over steel construction, bronze, galvanized or other non-corroding bolts and washers are used. Sheets should be fastened along laps on approximate 9″ centers, and to all rafters on approximate 10″ centers.

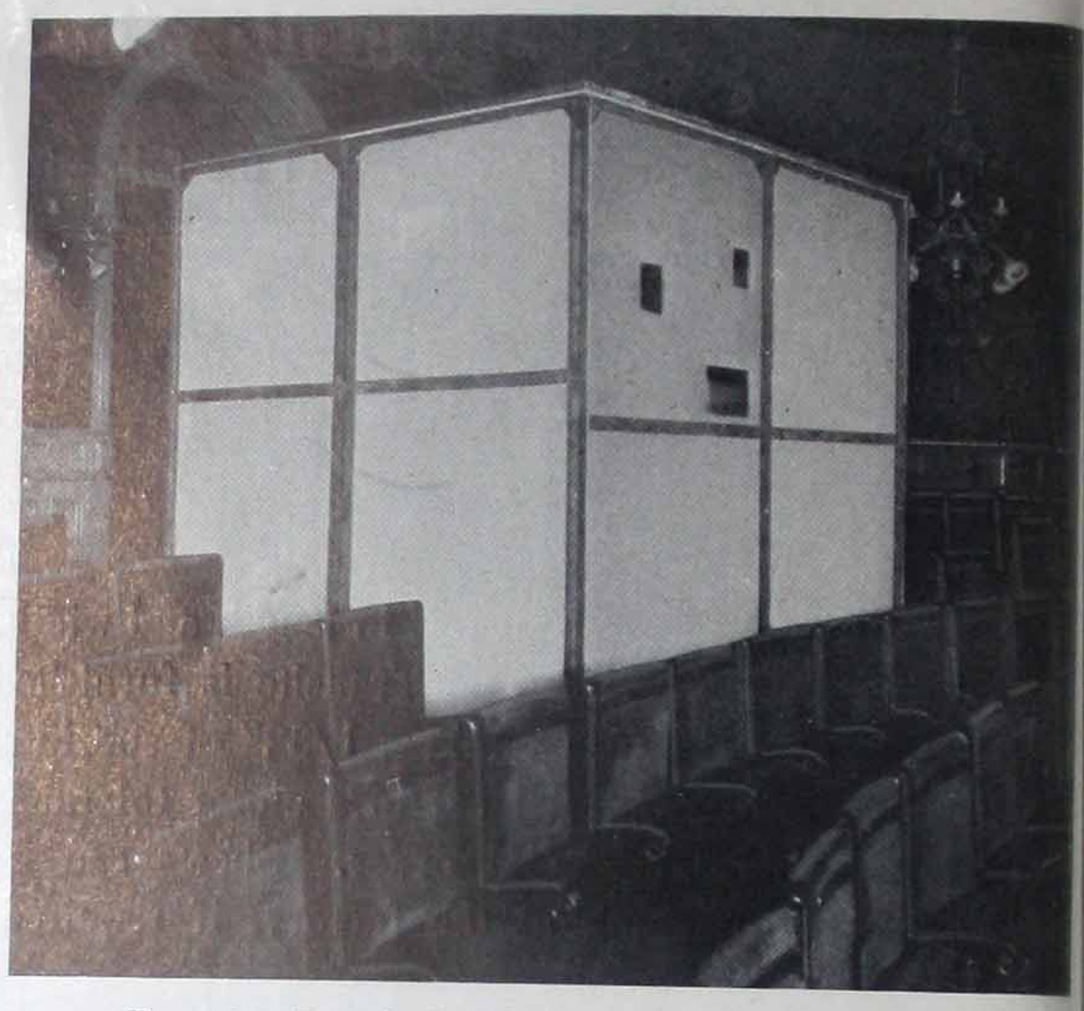


Lipped Flat Transite construction details

The ends of the sheets should be butted, over which a lipped Transite batten 4″ wide should be used. J-M Black Asbestos Roof Putty and Asbestos Felt Gaskets should be used in all laps and under battens. All bolt and screw heads should also be covered with the Black Asbestos Roof Putty.

Transite Motion Picture Booth

Because of the high inflammability of motion picture film, laws have been enacted in practically all states requiring that the projecting machine be housed in a fireproof booth or enclosure. Transite booths conform to the requirements in most of these states as well as to the regulations of insurance companies covering fireproof booths. They have many advantages over sheet metal booths, including lower sound transmission, greater fire resistance, higher



Transite Panel Booth in school auditorium

electrical resistance and more attractive appearance. Transite is a pleasing light gray in color, and can be painted if desired to match interior trim.

These booths are built of Flat Transite sheets, ¼″ thick on sides and top and ⅜″ thick on floor, assembled on a steel frame. Panels are plainly marked so that they can be easily put together by any carpenter without the necessity of fitting, filing or drilling. The Transite is bolted on the inside of the skeleton frame, thus insulating the frame from electrical currents and making the booth fireproof. Joints are pointed up with J-M No. 20 Plastic Refractory Cement, providing smoke-tight construction.

A complete ventilating system, with galvanized iron pipe flues and an exhaust fan, can be furnished.

The Transite booth can be easily enlarged by the addition of standard panels which can also be furnished mounted on the standard steel frame.

List Prices and Weights of Standard Booths

Booth	Approximate Outside Dimensions	List Price	Crating* Extra	Approx. Crated Weight, lb.
Junior	4′ 0″ x 6′ 3″ x 7′ 1½″ high	$150.00	$12.50	850
No. 1	6′ 3″ x 8′ 0″ x 7′ 1½″ high	225.00	15.00	1350
No. 2	8′ 3″ x 9′ 0″ x 7′ 1½″ high	275.00	17.50	1700
No. 3	8′ 3″ x 12′ x 7′ 1½″ high	300.00	17.50	2250
No. 4	9′ 3″ x 12′ x 7′ 1½″ high	350.00	20.00	2300
No. 5	8′ 3″ x 14′ x 7′ 1½″ high	375.00	22.50	2400
No. 6	9′ 3″ x 14′ x 7′ 1½″ high	425.00	25.00	2550

*All shipments by express or freight must be crated.

Printed in U. S. A.

Transite Core Plates and Transite Pallets

ansite Core Plates and Transite Pallets are thly sanded trays of specially compounded and ed Flat Transite. The core plates are used for ing cores during the drying or baking processes. pallets are used in the ceramic and abrasive in- ries. Both are light in weight, rustless and of ex- nt hearth quality.

re plates made from Transite have been enthusi- ally received by the many foundries that have them, including concerns manufacturing castings rass, aluminum, gray iron, malleable iron and . They have found that Transite offers the fol- ng advantages:

uch lighter in weight than cast iron or steel, which means eedier production.

es not corrode or rust like cast iron or steel. The sur- e of the plate remains smooth after years of use.

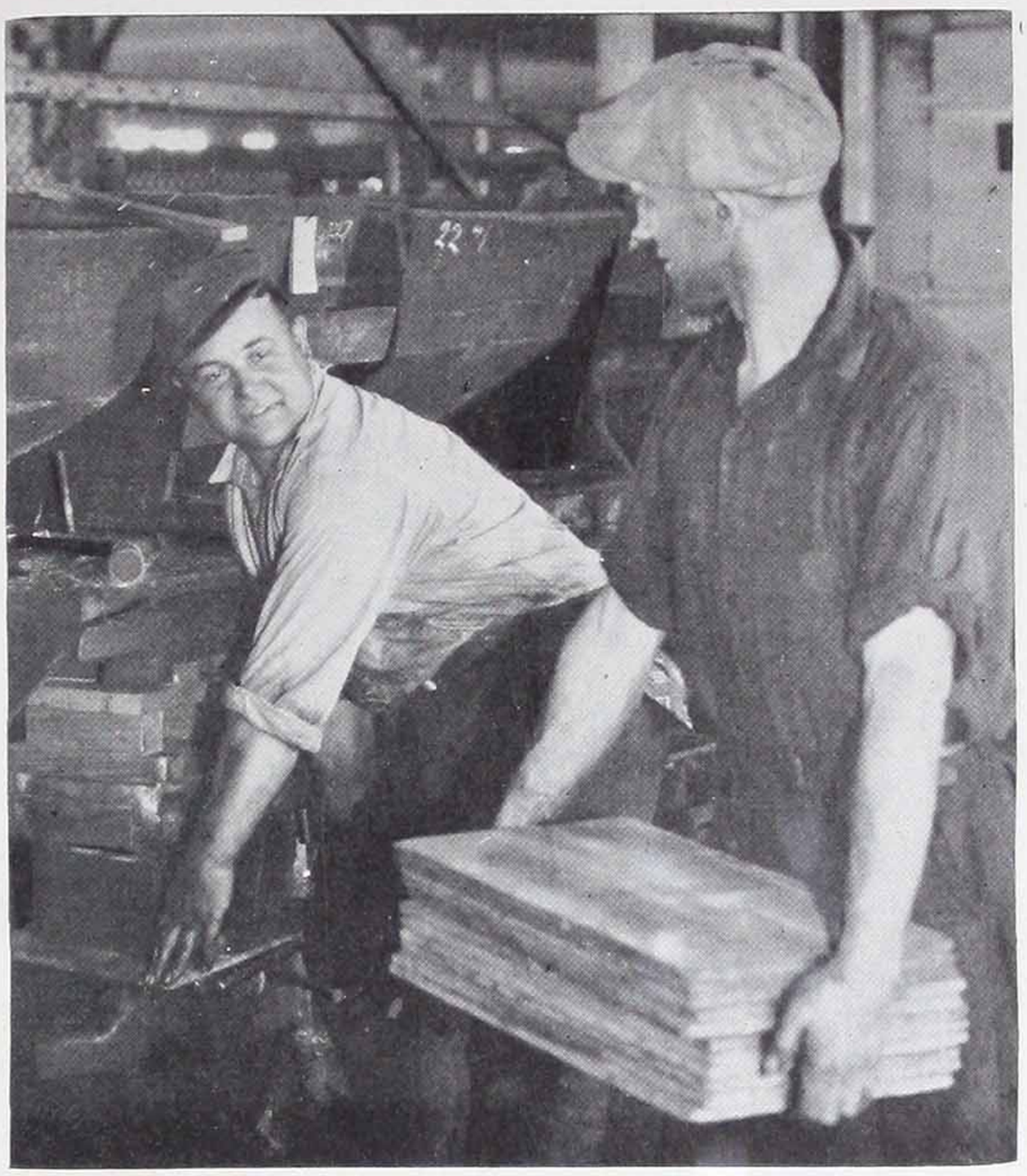
cause of its fibrous nature, it does not crack or break as sily as cast iron when dropped.

es not warp under heat like steel.

as a slower rate of heat transmission which results in tter cores and permits handling of hotter plates.

re wash, sand, etc., do not stick as readily to Transite re Plates as to those made of cast iron and steel.

ny core that can be made on a steel plate can be e on a Transite plate.



Transite Core Plates are easily handled

Light Weight

Transite plate weighs about one-fourth as much steel or iron plate of the same size and thickness. e each core plate is handled about five times in process of making, drying, baking and finishing a , this reduced weight is an important factor in the ding up of output and in the lowering of produc- costs in the shop. This is especially true in all ndries where core plates are handled by man er. With Transite, often one man can handle led plates formerly requiring two. Core moulders er Transite plates to the heavier metal plates.

he weight of Transite Core Plate material is ap- timately 124 lb. per cu. ft. For a similar volume iron weighs about 450 lb., and steel 490 lb. Even minum, which is sometimes used as a core plate erial, weighs 166 lb. per cu. ft.

Good Baking Characteristics

he hearth quality of Transite, which is responsible better baking characteristics, lies not only in its ntion of the heat absorbed but also in the greater uniformity of temperature maintained over the sur- face of the plate.

The impregnations and baking treatments given to Transite Core Plates during manufacture render the material water-resisting and are responsible for the reduced warping tendency of the product.

Ribs Unnecessary

Cast-iron core plates have to be ribbed to prevent excessive warping. Transite plates need not be ribbed, which permits using both sides of the plate for bak- ing cores, thus increasing the life of the plate.

Some foundries point out that the angles or ridges on the bottom of cast iron plates are advantageous because they hold the plate off the bench so that it can be picked up more easily. The same result can be accomplished with Transite by placing two wood strips on the bench on which to set the plate.

The advantage of a core plate without reinforcing angles is that less of the draw distance is absorbed in a core making machine. It also permits higher cores to be handled between racks on the dryer car, and is less liable to snag and develop sharp edges or splinters to cut the workers' hands.

Accuracy of Transite Core Plates

Transite Core Plates are much more accurate than ordinary steel plates and are equal in accuracy to new hammered steel plates and average cast-iron plates.

For large flat cores of thin section where extreme accuracy is required a careful selection of plates is always necessary with any core plate.

A warpage tolerance of not over 1/64″ in 24″ length has been established for Transite Core Plates.

Economy

Plain steel plates sheared from soft plate stock make the cheapest core plates available. However, they warp quite readily and have to be replaced frequently.

Hammered or reinforced steel plates equal or exceed the cost of Transite Core Plates and do not give as good general service. They show decided warping tendencies and have little reclamation value.

The ribs of the cast iron make for an extremely heavy plate, costing much more than Transite when machined and ready for use. Transite Core Plates give service comparable to cast iron at much less cost.

Reclaimability

After serving their usefulness as core plates, the Transite may be used for making bottom boards, moulders' bench tops, core dryers and mould jackets.

When used in place of wood or metal as bottom boards or mould slips, Transite has special advantages. A run-out of hot metal burns wood, causing smoke, and freezes onto cold metal, warping it out of shape. However, when hot metal meets Transite it usually chills, stops the run-out, saves the casting and prevents accidents.

If a Transite plate merely needs truing, it is a simple matter to run it on the surface grinder or rubbing wheel. This is seldom necessary where the plates are laid flat on a level surface in storage and kept as dry as possible.

Other Uses

The same stock that is used for Transite Core Plates is excellent for making match plates, moulders' bench tops and bottom boards. Recommendations will be furnished upon receipt of information relative to the prospective use.

Transite Pallets

Transite Pallets are identical in composition and treatment with Transite Core Plates. They are used in the production of silica bricks and shapes, soft mud bricks, terra cotta, china, porcelain, and abrasive wheels and shapes. The smooth surface and low water absorption of Transite Pallets allow the ware to creep freely as it shrinks in the drying process. Their low rate of heat transmission as compared with some other types of material, provides more even drying and thus eliminates the tendency of the ware to warp and crack. Transite Pallets embody all the advantages of Transite Core Plates.

Sizes and List Prices

Transite Core Plates and Transite Pallets are furnished in the following thicknesses: 1/4″, 3/8″, 1/2″, 5/8″, 3/4″, 7/8″, 1″, 1 1/4″, 1 1/2″, 1 5/8″, 1 3/4″ and 2″. Manufacturing tolerances are ± 1/16″ except as to thickness which is ± 1/32″. The thickness of unit required varies with the necessary area.

Proper Thickness for Various Size Plates

Size of Plate	Thickness	Size of Plate	Thickness
6″ x 6″	1/4″	18″ x 24″	3/4″
6″ x 12″	3/8″	18″ x 30″	7/8″
6″ x 18″	1/2″	18″ x 36″	1″
6″ x 24″	3/4″	18″ x 42″	1 1/4″
6″ x 36″	1 1/2″	18″ x 48″	1 1/2″
6″ x 42″	1 5/8″	24″ x 24″	3/4″
6″ x 48″	1 3/4″	24″ x 30″	7/8″
12″ x 12″	3/8″	24″ x 36″	1″
12″ x 18″	1/2″	24″ x 42″	1 1/4″
12″ x 24″	1/2″ 5/8″	24″ x 48″	1 1/2″
12″ x 30″	3/4″	30″ x 24″	7/8″
12″ x 36″	1″	30″ x 30″	1″
12″ x 42″	1 1/4″	30″ x 36″	1 1/4″
12″ x 48″	1 1/2″	30″ x 42″	1 1/2″
18″ x 12″	1/2″	30″ x 48″	1 3/4″
18″ x 18″	5/8″		

For sizes of units in between those in the above schedule, the next greater thickness should be used. For example, a unit 30″ x 34″ should be ordered 1 1/4″ thick. If thinner units are employed, then the deflections may cause difficulties.

Weights and List Prices Per Sq. Ft.

Thickness, inches	Uncrated Weight, lb.	Crated Weight, lb.	List Prices
1/4	2.6	2.8	$0.30
3/8	3.9	4.2	.45
1/2	4.7	5.0	.60
5/8	6.7	7.2	.75
3/4	7.5	8.2	.90
7/8	8.7	9.4	1.05
1	9.9	10.7	1.20
1 1/4	12.8	13.8	1.50
1 1/2	14.0	15.2	1.80
1 5/8	15.3	16.6	1.95
1 3/4	16.8	18.3	2.10
2	19.6	21.2	2.40

Transite core plate stock will not be furnished in large sheets for field cutting because of the impossibility of properly sealing the edges with impregnant when this is done. Ribbed Transite Plates will be specially moulded to order upon receipt of sketch.

All pallets are factory-made to suit requirements.

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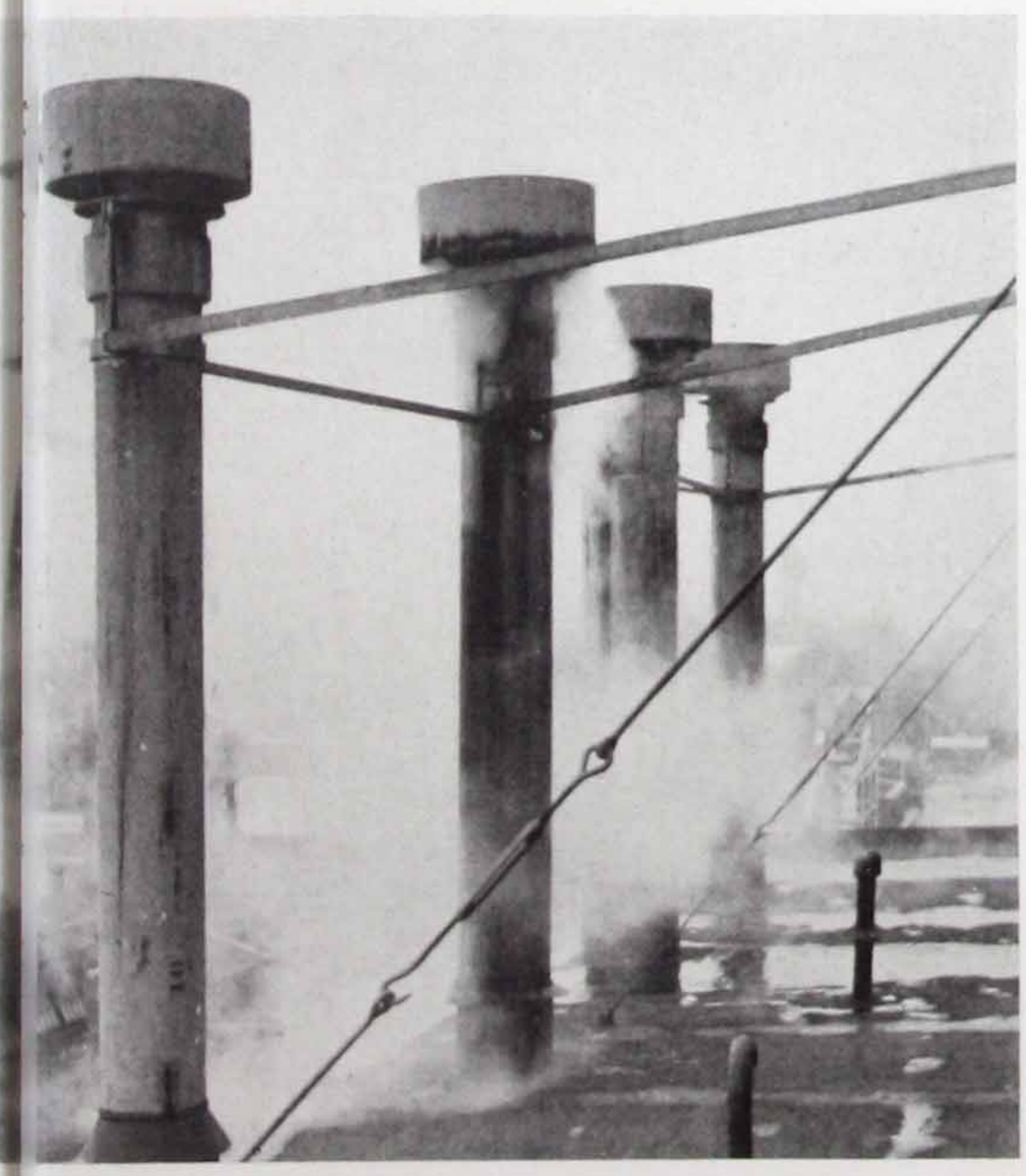
Transite Pipe

e conveyance of liquids and gases is so essential odern industrial and community life that uninter- ed, economical service is imperative. To provide service, whether in the transportation of liquids the venting of fumes or flue gases, the pipe must t the disintegrating action of many different agen- For this reason, Transite Pipe, which is com- d of more enduring and inert ingredients, pro- s more satisfactory service than is otherwise narily available.

ansite Pipe is composed of asbestos and cement, durable materials, combined under heavy pressure smooth steel mandrel into a dense, homogeneous cture. This pipe offers the primary advantages of installation, economical service and long life.

ecause of its composition and the method of manu- ure, Transite Pipe has many other advantages h render it suitable to a wide range of uses, in- ing—as well as pipe lines—flues, vents and stacks. e of these advantages are immunity to electrolysis tuberculation, resistance to corrosive action, low conductivity, incombustibility and light weight. nce 1900 Johns-Manville has combined asbestos cement, under pressure, to fabricate a waterproof,



ansite Pipe, Class S, in service at a chemical plant, venting the corrosive fumes of various processes

Transite Pressure Pipe with Simplex Couplings is used to convey water from the city water main to the power plant of Forstmann Woolen Mills, Garfield, N. J.

corrosion-resisting, fireproof material, known as Transite. In 1929 the manufacture of Transite in pipe form was begun under process patents owned by Societa Anonima "Eternit" Pietra Artificiale, Genoa, Italy. Subsequently, many million feet of Transite Pipe have been installed in the United States and Canada for use as underground water mains, process liquor lines, flue and vent pipes. A pipe of this nature has been manufactured in Italy since 1913 and has found wide adaptation in other countries.

Classes of Transite Pipe

Class designation	Working pressure, lb. per sq. in.	Equivalent head, feet of water
F	0	0
S	0	0
50	50	115
100	100	231
150	150	346
200	200	462

Physical Properties:

When asbestos fibre is combined with cement, under pressure, a very strong material is produced. The asbestos fibres act like the steel in reinforced concrete but with the important advantages that the fibres are

ed in U.S.A.

Transite Flue Pipe affords efficient service in venting flue gases from domestic heating appliances

corrosion-resisting and are thoroughly mixed with the cement. These factors provide uniform strength values throughout the material during its entire life. The toughness and strength of Transite Pipe are directly traceable to the reinforcement of the asbestos fibre. Furthermore, the strength of Transite, like that of other cement products, increases in the presence of moisture and improves with age. The pipe is sufficiently strong, when properly installed, to withstand any normal load that will be placed upon it.

Because of its non-metallic nature, Transite Pipe is immune to rust and electrolysis. It is not subject to ferruginous tubercles and sponge which soften the walls, pollute the contents and greatly reduce the carrying capacity of other types of pipe.

The method of manufacture insures a smooth interior surface which offers little resistance to the flow of liquids or gases. This low coefficient of friction is perserved throughout the life of the pipe because of its immunity to tuberculation.

Transite Pipe is incombustible and, when used as a stack or vent to carry off products of combustion with temperatures to 700 deg. F., will fulfil all the requirements without either cracking or buckling. Resistance to the action of corrosive gases makes it an economical material even under severe service conditions.

When compared with metal, Transite has a low rate of heat conductivity. Its use for venting flue gases retards drop in temperature, thus decreasing condensation and improving draft.

Transite Pipe is relatively light, weighing approximately 125 lb. per cu. ft. of material. It is considerably lighter than metal pipe even though the wall thickness is somewhat greater. Lightness of weight makes for economical handling and rapid installation. All but the largest sizes of Transite Pipe can be installed without mechanical assistance.

Uses of Transite Pipe:

In general, Transite Pipe is recommended wherever metal pipe might be used, except in locations where abrasive action and impact are especially severe.

Following are some typical applications of the various classes of Transite Pipe:

Transite Pressure Pipe
(Classes 50, 100, 150 and 200)

Water supply and distribution mains
Storm sewer lines
Mine drainage and sluices
Brine lines
Process liquor lines
Pure water lines for chemical plants
Drainage and culverts
Irrigation lines
Large stacks

Stack and Vent Pipe
(Class S)

Stacks and vents for corrosive vapors
Laboratory vent systems
Air ducts
Exhaust and blower systems

Transite Flue Pipe
(Class F)

Flues and flue linings
Vents for domestic gas-burning appliances

Hundreds of municipalities and industrial plants throughout the country are finding the answer to their water transportation problems in Transite Pressure Pipe. Class S Pipe is rapidly gaining recognition in industry as the outstanding material for venting acid fumes, corrosive vapors and products of combustion. Transite Flue Pipe (Class F) has a successful service record in providing permanent, non-corroding flues for domestic gas-burning appliances. The unprecedented demand for the different classes of Transite Pipe proves that these products satisfy a long-felt need.

A more detailed discussion of the individual types of Transite Pipe is given on other data sheets.

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Transite Flue Pipe

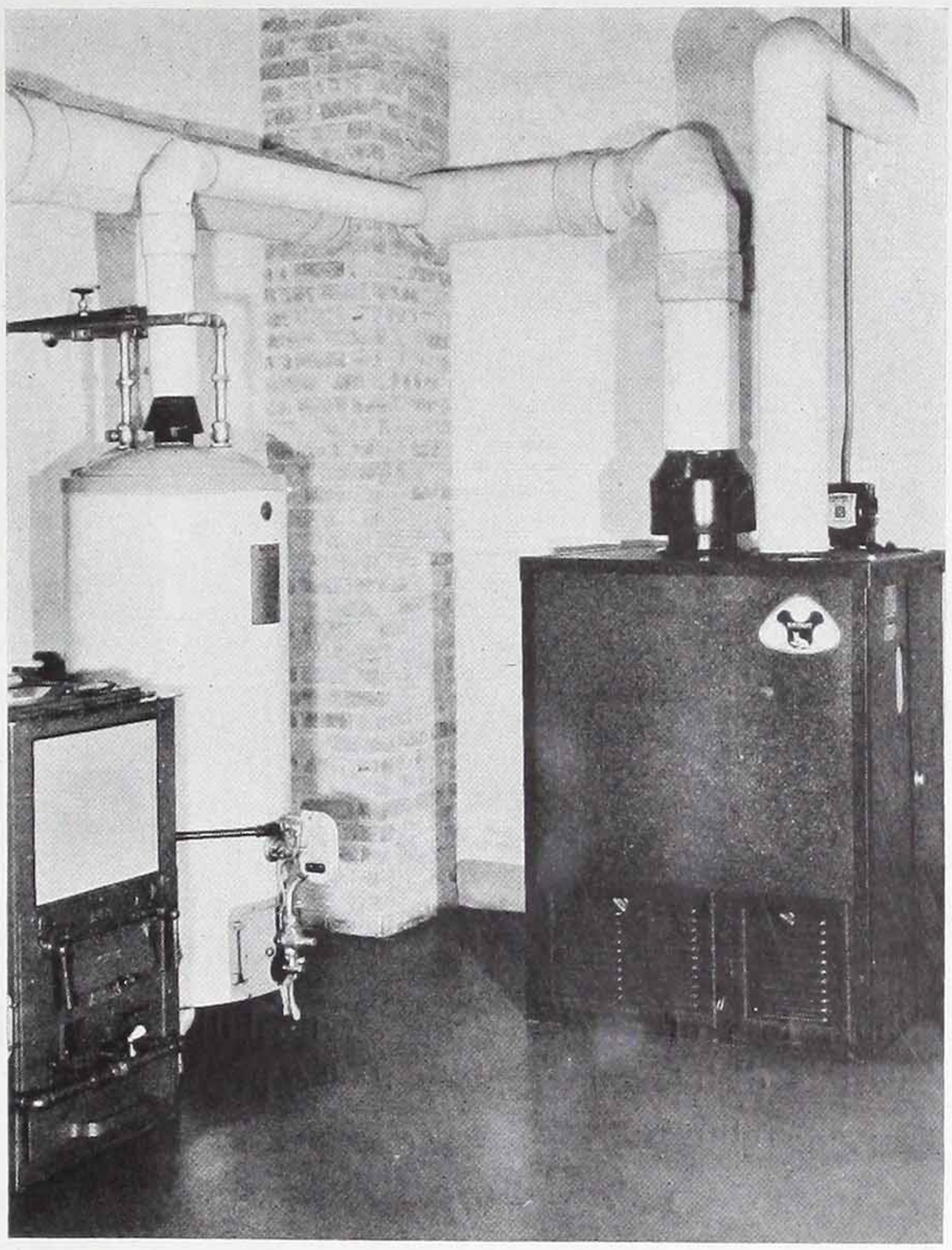
s proved by long experience, the ideal flue pipe, either indoor or outdoor use, should be perma-, non-corroding, relatively low in heat conductiv- and of high temperature resistance. Transite Flue e is just such a product, especially designed for ing gas-burning appliances.

ike other Transite products, this pipe is manufac- d from asbestos fibre and portland cement and has durable qualities of both. Since 1900, Transite fing and Siding have been distinguished by perma- ce in service. The same material in the form of e has identical endurance.

ermanence: The great reason for the use of gas with either a new or existing appliance is con- ience and dependability in operation. The unit t function perfectly, day in and day out, with e attention and practically no maintenance.

he demand for durability in the vent is easily met using Transite Flue Pipe—the best insurance inst faulty venting of flue gases.

orrosion-Resistance: Resistance to corrosion is ntial because the products of combustion in com- ation with moisture produce weak acids which at-



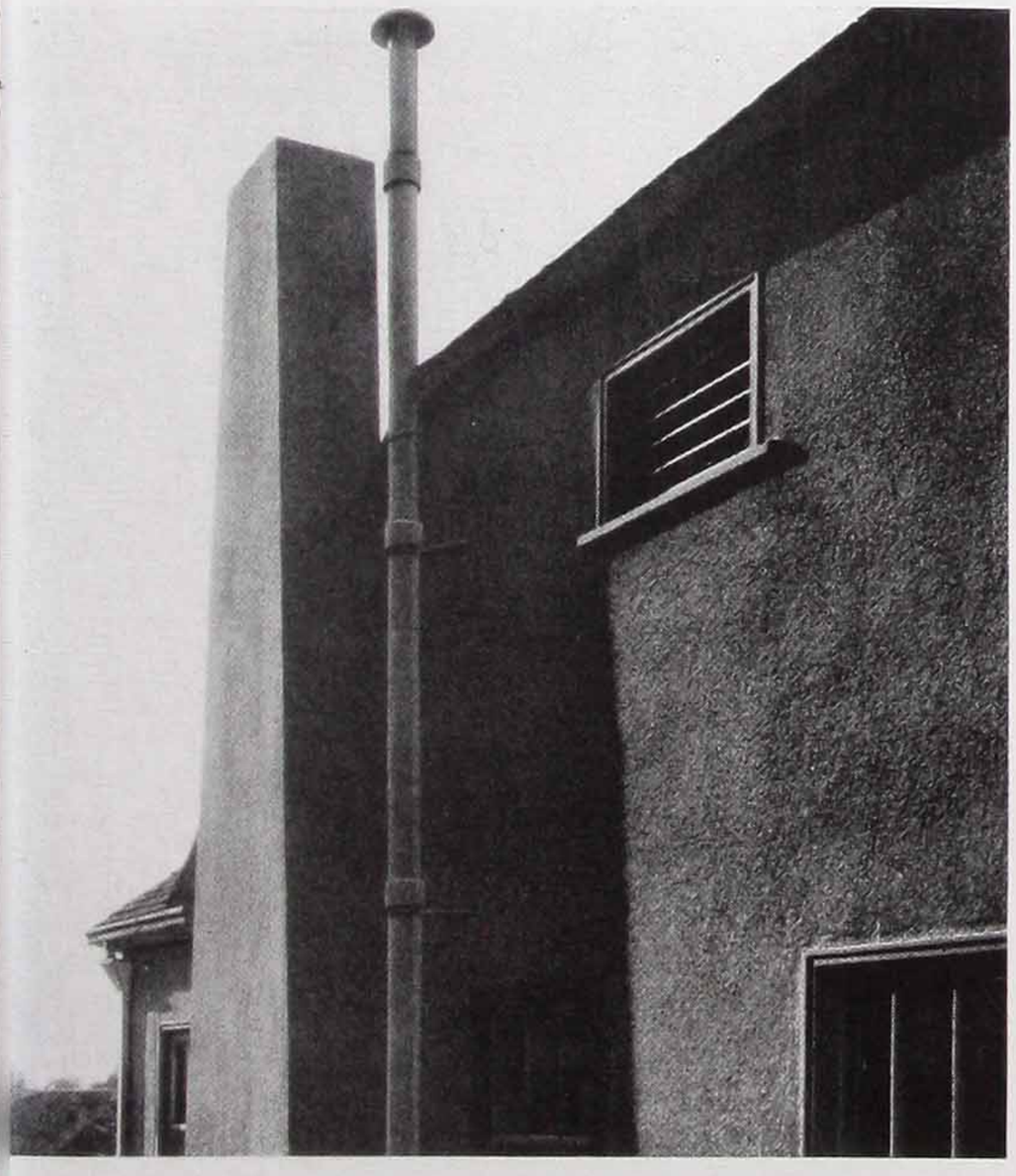
Gas-fired water heaters and boilers are safely vented with Transite Flue Pipe

tack ordinary flues and cause rapid disintegration. Transite Flue Pipe is practically immune to such acid action, as is evidenced by thousands of installations.

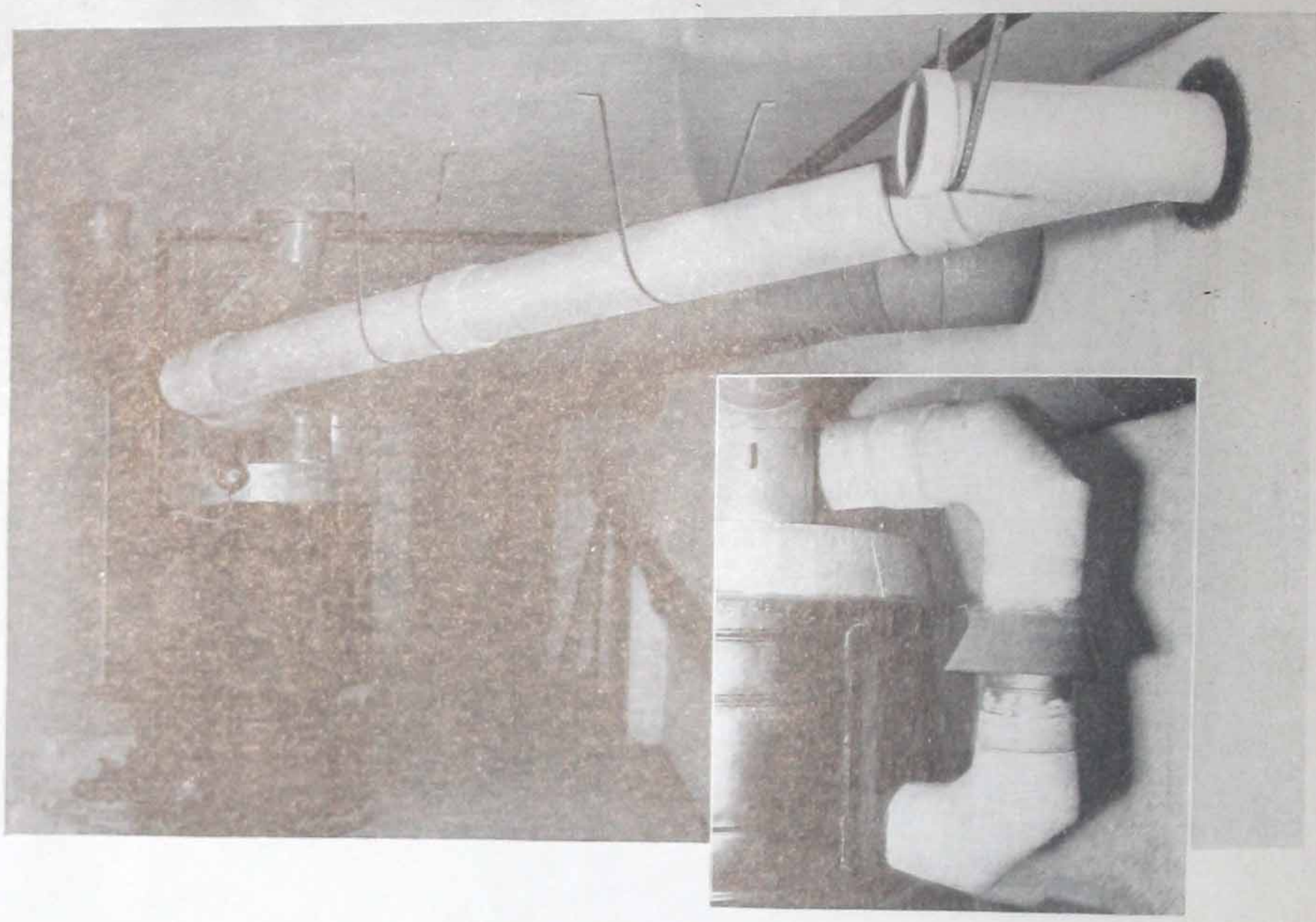
When exposed to the destructive influence of the elements, Transite Flue Pipe does not discolor and will not stain adjoining parts of the building. Its smooth surface, a pleasing grayish-white in color, presents a neat, attractive appearance, but it can readily be painted if desired.

Low Heat Conductivity: Low heat conductivity is important for several reasons. It assures higher flue gas temperatures, which are necessary for proper exhaust, and it reduces the fire hazard in frame buildings. Higher flue gas temperatures also tend to prevent condensation of moisture on the inside of the flue pipe.

High Temperature Resistance: Transite Flue Pipe can be used for flue gas temperatures to 700 deg. F.,



nsite Pipe affords a neat and durable gas-heater vent for private homes



A typical basement installation of Transite Flue Pipe, showing gas furnace connections. Sections of pipe are tightly joined with cemented couplings

without loss of efficiency or serviceability. Some materials disintegrate rapidly under prevailing flue gas temperatures.

Underwriters' Approval:

Transite Flue Pipe (which is also known as Transite Pipe, Class "F") has been tested by the Underwriters' Laboratories, Inc., for use as an outlet or vent piping on domestic gas-burning appliances, has successfully passed all the requirements and carries the approval of that organization.

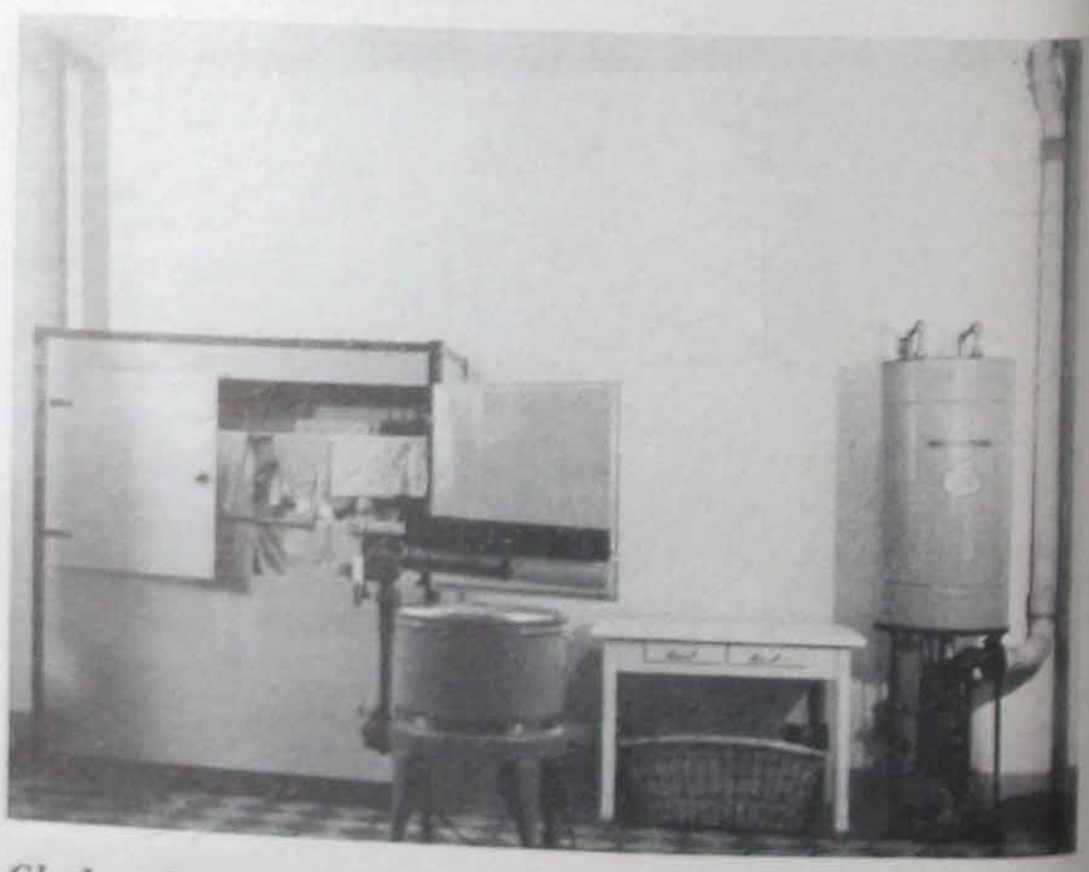
Sizes and Shapes:

Transite Pipe, Class "F," is furnished in round cross-section in sizes from 2″ to 8″, I.D., in standard lengths of 5′0″; and 8″ to 12″, I.D., in standard lengths of 6′6″. The larger mentioned sizes are furnished in 5-ft. lengths on the Pacific Coast. Round pipe and fittings are furnished with couplings unattached.

Transite Flue Pipe is also furnished in oval cross-section, in lengths of 5 ft. and 10 ft., for use where it is desired to run a flue through an interior partition or exterior wall constructed of 4″ studs. For convenience, the sizes of this pipe are designated as 3″, 4″, 5″ and 6″. These sizes are those of round pipe of an equivalent venting capacity.

The interior cross-sections of Transite Oval Pipe are actually 2¼″ x 4¼″, 2¼″ x 6⅝″, 2¼″ x 9¾″ and 2¼″ x 11¼″, to correspond to the round sizes enumerated above. The outside narrow dimension of all four sizes is 2¾″. The corresponding dimension of all oval couplings is 3⅝″.

The table adjoining the dimension drawing of oval pipe on the reverse of Data Sheet BMT-412 shows the ratios of the oval and round areas. Each length of oval pipe and each fitting is furnished with one coupling cemented on at the factory.



Clothes dryer and water heater, vented with Transite Pipe

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tings and Couplings:

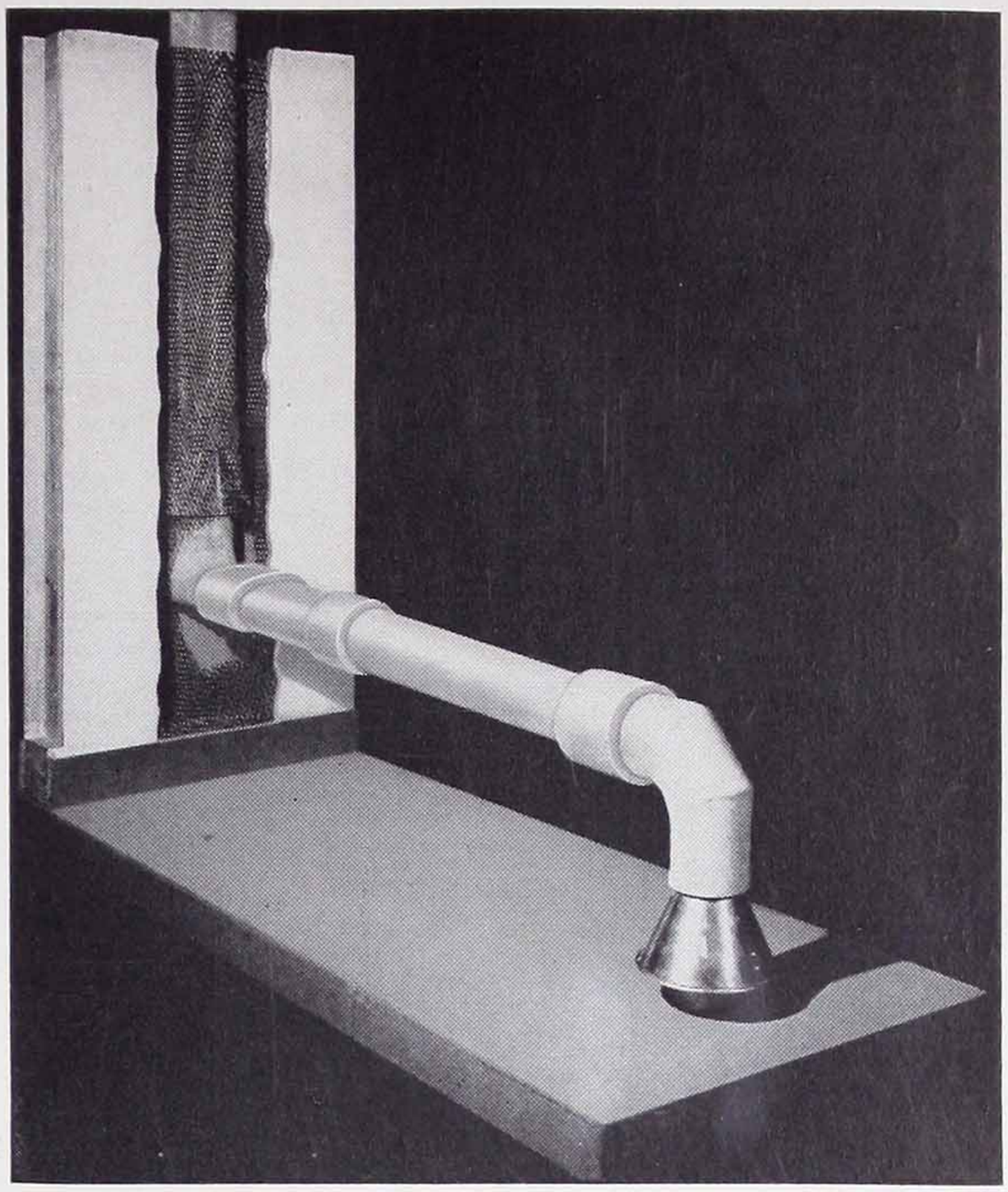
Round Transite Flue Pipe is tapered at both ends l all fittings are tapered on all legs so that any two ces may be joined together by the use of a tapered pling. In order to provide for field cutting of a e, a Duplex coupling is available with one tapered let and one bell to receive cut piece.

The ends of Oval Transite Pipe and Fittings are cut are. The joints are formed with an oval coupling, ich provides a space of $\frac{3}{16}$″ for cementing.

int Cement:

Transite Flue Pipe Cement is a ready-mixed mate- l for use in all pipe joints and openings in brick l stonework through which pipe may pass. For ered couplings, enough water is added to the ce- nt to provide a thick creamy consistency; for plex and oval couplings, the cement is mixed to a ste consistency.

Transite Flue Pipe Cement air sets. The pipe need be wet before application of the cement. Case dening occurs in three to four hours; a $\frac{1}{8}$″ joint ches full strength in approximately 24 hours and a ′ joint, in approximately two to three days. The nent, after attaining full strength, will hold its bond



Transite Pipe erected to illustrate the connections used between a round heater vent and an oval wall flue

*List Prices and Approximate Weights of Round Transite Flue Pipe and Fittings**

e	Pipe, per ft., including 1 Coupling		45° Elbows, including 1 Coupling		90° Elbows, including 1 Coupling		Short-leg Tees, including 2 Couplings		Long-leg Tees, including 2 Couplings		Laterals, including 2 Couplings		Tapered Couplings (Extra)		Duplex Couplings (Extra)		Drip Caps		Ventilator Top		Cone Tops**
	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	List Price	Wt. lb.	Wt. lb.
	$0.50	2.2	$2.00	2.40	$2.80	2.90	$3.00	4.30	$3.30	5.30	$3.20	5.55	$0.50	0.9	$1.07	1.6	$1.00	0.35	$4.00	1.7	4.6
½	.60	2.6	2.40	3.05	3.35	3.55	3.60	5.35	3.95	6.50	3.85	7.60	.60	1.05	1.16	1.7	1.20	0.65	4.80	2.3	4.9
	.70	3.4	2.80	3.85	3.90	4.60	4.20	6.70	4.65	8.10	4.50	10.45	.70	1.35	1.25	2.1	1.40	1.0	5.60	3.4	6.1
½	.85	3.9	3.40	4.50	4.75	5.75	5.15	8.75	5.65	10.25	5.45	12.00	.85	1.75	1.50	2.2	1.70	1.15	6.80	4.5	7.0
	1.00	4.3	4.00	4.95	5.60	7.20	6.00	10.40	6.60	11.90	6.40	12.65	1.00	1.95	1.83	2.5	2.00	1.35	8.00	5.3	7.4
½	1.15	5.2	4.60	5.45	6.45	8.70	6.90	12.65	7.55	14.50	7.35	14.15	1.15	2.2	2.30	3.4	2.30	1.75	9.20	7.0	8.4
	1.30	5.9	5.20	6.45	7.30	10.45	7.80	15.65	8.60	17.60	8.35	17.40	1.30	2.95	2.35	3.7	2.60	2.5	10.40	10.0	11.25
	1.55	6.9	6.20	8.25	8.70	13.00	9.30	18.50	10.25	20.80	9.90	23.25	1.55	3.0	2.78	4.2	3.10	3.0	12.40	14.7	15.55
	1.85	9.2	7.40	11.75	10.40	15.00	11.10	21.00	12.20	24.10	11.85	31.50	1.85	4.0	4.24	7.6	3.70	3.3	14.80	20.6	18.0
	2.15	10.7	8.60	17.10	12.00	20.35	13.00	27.70	14.30	31.20	13.80	45.95	2.15	6.6	5.77	8.4	4.30	4.2	17.20	27.5	19.3
	2.85	13.4	11.40	22.45	16.00	32.20	16.50	43.40	18.10	46.70	18.25	63.90	2.85	8.2	7.57	10.2	5.70	5.4	22.80	46.3	27.9
	3.60	18.4	14.40	36.00	20.20	57.00	21.60	70.00	23.75	74.60	23.00	95.50	3.60	12.0	10.50	16.2	7.20	6.7	28.80	75.4	36.8

List Price of Reducers: $1.00 per inch of large diameter, e.g. 6″ to 4″, list price $6.00.
Weight of Reducers: Approximately 0.5 lb. per inch of large diameter, e.g. 6″ to 4″ weighs 3 lb.

*The list prices include couplings where specified. The weights given are for the individual fittings, including couplings where specified. Weights are subject to a tolerance of plus 5 percent.

**List Price of Cone Tops same as Short-leg Tees for respective pipe sizes.

List Prices and Approximate Weights of Oval Transite Flue Pipe and Fittings

uivalent nd Pipe size, inches	Inside dimensions, inches	Pipe per ft. including 1 Coupling		Extra Couplings		90° Elbows including 1 Coupling		45° Elbows including 1 Coupling		Tees† including 1 Coupling		Adapter including 1 Coupling		Drip Caps	
		Weight, lb.	List Price	Weight, lb.	List Price	Weight, lb.	List Price	Weight, lb.	List Price	Weight, lb.	List Price	Weight, lb.	List Price	Weight, lb.	List Price
3	2¼ x 4¼	2.5	$0.70	1.1	$1.10	3.5	$3.90	3.5	$2.80	4.5	$4.20	3.5	$3.00	0.8	$1.40
4	2¼ x 6⅝	3.4	1.00	2.2	1.30	5.8	5.60	5.8	4.00	7.5	6.00	5.2	4.00	1.3	2.00
5	2¼ x 9¾	4.2	1.30	3.0	1.55	9.3	7.30	9.3	5.20	13.4	7.80	8.6	5.00	2.0	2.60
6	2¼ x 11¼	5.1	1.55	3.6	2.00	10.6	8.70	10.6	6.20	18.0	9.30	10.0	6.00	2.5	3.10

†Tees are supplied with either oval or round branch outlet.

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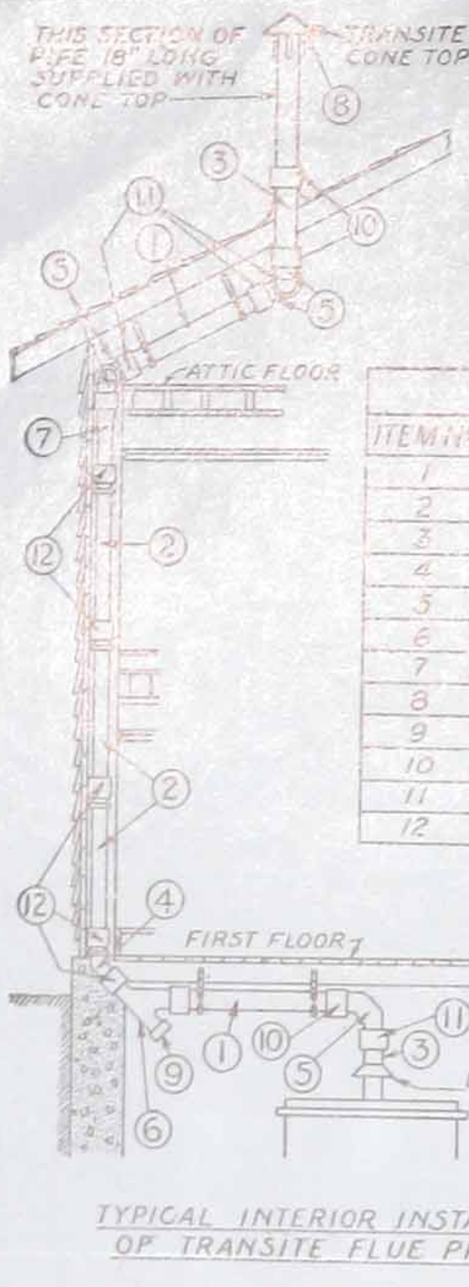
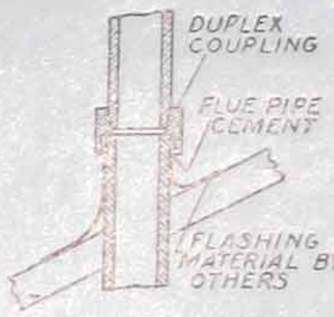
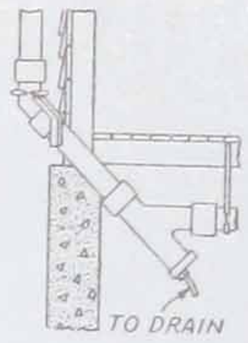


TYPICAL INTERIOR INSTALLATION OF TRANSITE FLUE PIPE

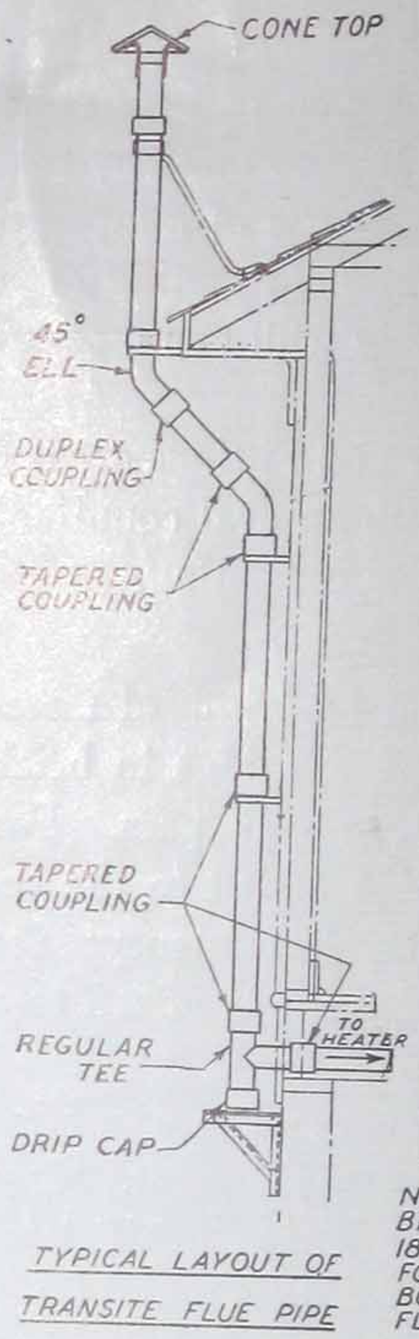


DETAIL OF FLASHING

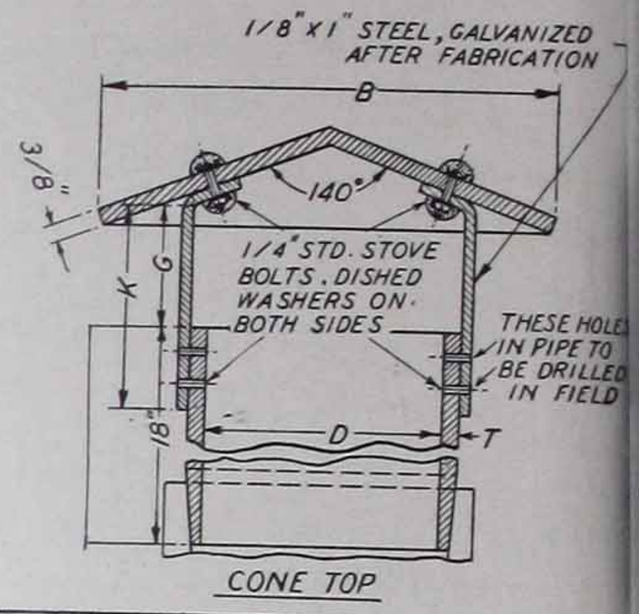
BILL OF MATERIALS		
ITEM Nº	QUAN.	DESCRIPTION OF MATERIALS
1	2	4"D. x 5'L. CLASS F TRANSITE PIPE
2	3	4"D. x 5'L. OVAL TRANSITE FLUE PIPE
3	1	4"D. x 5'L. CLASS F TRANSITE PIPE
4	1	4"D. 45° OVAL ELBOW
5	4	4"D. 90° CLASS F TRANSITE ELBOW
6	1	4"D. LATERAL, RUN OVAL, BRANCH R'ND.
7	1	4"D. OVAL TO ROUND ADAPTOR
8	1	4" TRANSITE CONE TOP
9	1	4" DRIP CAP (OVAL)
10	3	4" DUPLEX COUPLINGS
11	7	4" TAPERED COUPLINGS
12	5	4" OVAL RIB COUPLINGS



EXTERIOR INSTALLATION FOR COLD CLIMATES



TYPICAL LAYOUT OF TRANSITE FLUE PIPE



CONE TOP

PIPE SIZE D	T	B	G	K	NUMBER OF BRACKETS
INS.	INS.	INS.	INS.	INS.	
2	.30	5.00	2.00	6.00	2
2-1/2	.30	5.00	2.25	6.25	2
3	.32	6.00	2.63	6.63	2
3-1/2	.32	6.00	3.00	7.00	2
4	.32	8.00	3.50	7.50	2
4-1/2	.35	8.00	4.00	9.75	3
5	.35	10.00	4.50	10.25	3
6	.35	12.00	5.50	11.25	3
7	.40	12.00	6.00	12.75	3
8	.40	14.00	7.00	13.75	3
10	.40	16.00	8.50	16.25	4
12	.45	20.00	10.25	19.00	4

NOTE:- CONE TOP FURNISHED WITH CAP, BRACKETS, BOLTS, WASHERS, TAPERED COUPLING AND 18" OF PIPE. PIPE, CAP AND BRACKETS ARE DRILLED FOR BOLTS. CONE TOP SHIPPED KNOCKED-DOWN BOLT HEADS AND NUTS TO BE COVERED WITH FLUE PIPE CEMENT WHEN INSTALLED

under all atmospheric conditions and through the entire range of flue gas temperatures for which the pipe is recommended. It is furnished in 1, 5 and 10-lb. cans and in 25 and 50-lb. pails and must be ordered separately. The following tabulations give approximate quantities required per 100 joints:

Pipe Size, inches	Bell end of Duplex Coupling, lb.	One end of Tapered Coupling, lb.
2	48	6
2½	55	7
3	64	9
3½	72	10
4	91	13
4½	100	14
5	109	15
6	127	18
7	183	27
8	205	30
10	252	37
12	350	49

Equivalent area, round pipe size, inches	Inside dimensions, inches	One end of oval coupling, lb.
3	2¼ x 4¼	32
4	2¼ x 6⅝	42
5	2¼ x 9¾	72
6	2¼ x 11¼	82

Application of Transite Pipe

Transite Flue Pipe is quickly assembled and readily installed. It can be cut with a carpenter's saw or a hacksaw. Field cuts are ordinarily square and assembled with Duplex couplings. In some instances field tapering is desirable. For such purposes, a portable tapering tool is available. No special tools are required for any part of the assembly.

The round pipe fits over all standard round outlets of gas heaters; an adapter must be used if the outlet is oval. Its light weight makes the material easy to handle and support. Horizontal sections can be suspended with standard pipe hangers and vertical sections, with special brackets.

The portion of the vent from the appliance to the point at which the pipe enters the stud framing is frequently round pipe. Within the wall, between the studs, oval pipe is used. Round Transite Pipe with a cone or ventilator top is used for the upper portion of the flue which passes through the roof.

The transition from oval to round pipe may be readily accomplished by using a standard adapter at the point where the space between the studs is adequate or where pipe is exposed in closets or attics.

When pipe is run between studs, metal lath should be used for the plaster base over the space, and all combustible materials should be cut back at least 1" from the outside surface of the pipe.

At the bottom of vertical runs of pipe a drip cap should be installed in the line by cementing it to one branch of a lateral or tee as shown in the drawings.

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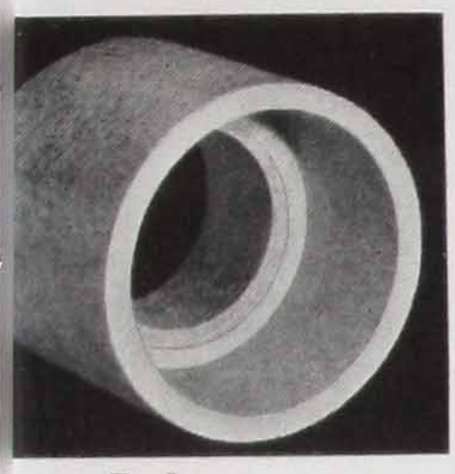
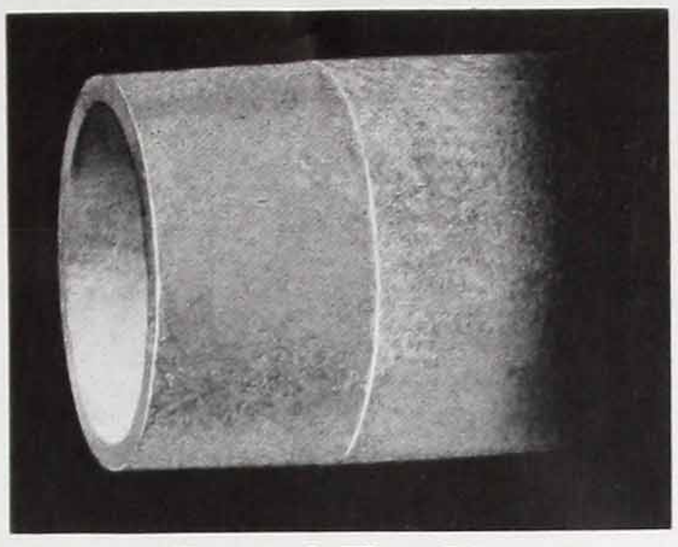
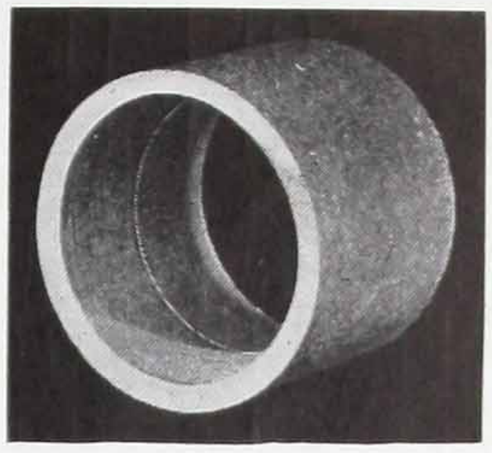
Round Transite Flue Pipe, Fittings and Couplings



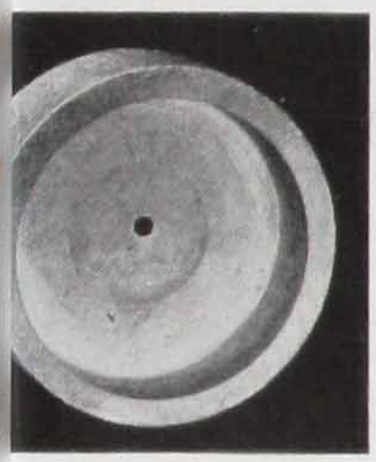
Reducer



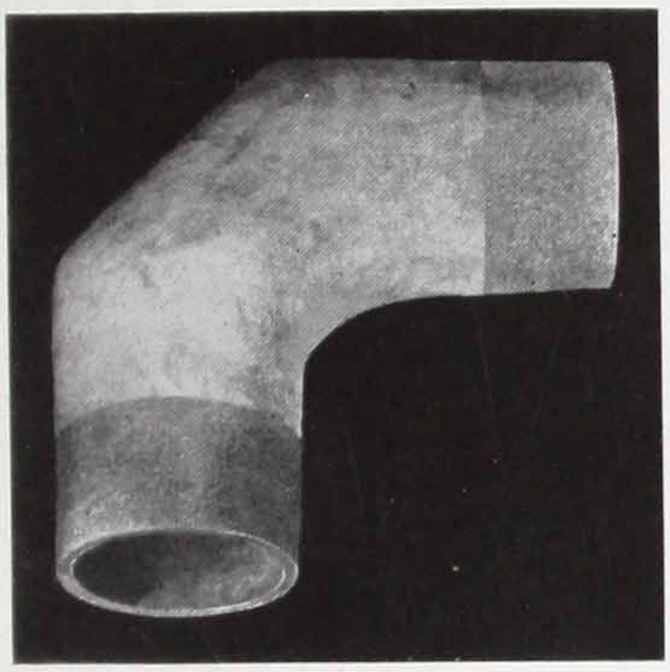
Tapered Flue Pipe



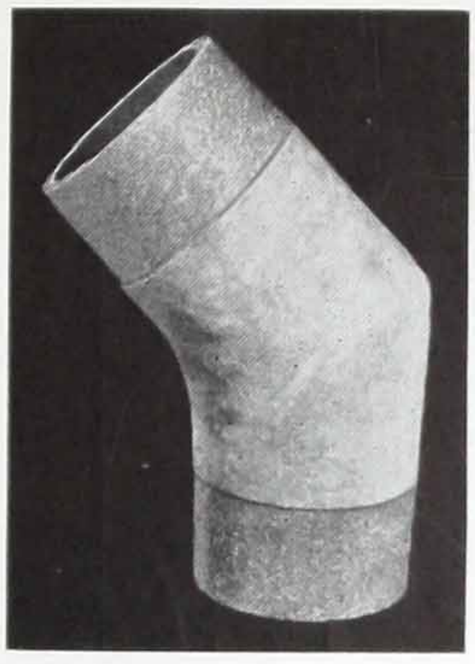
Tapered Coupling



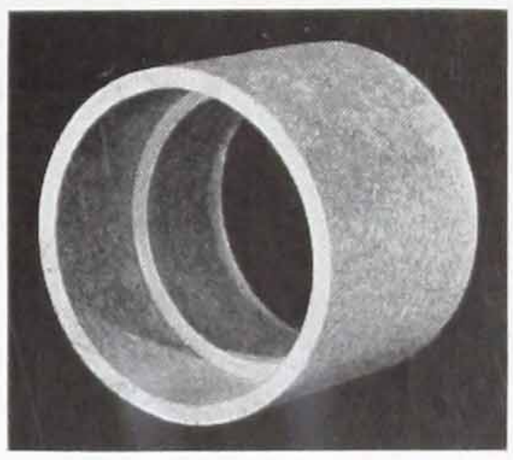
Drip Cap



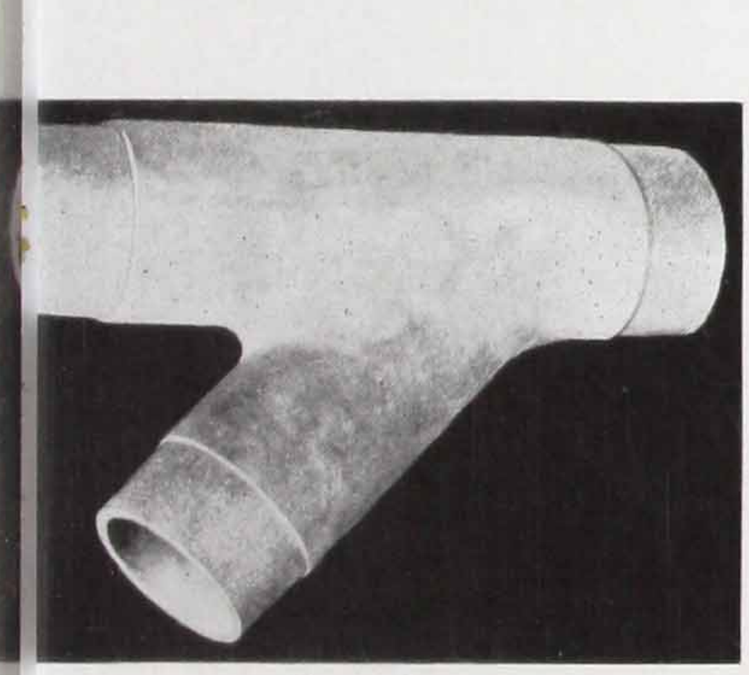
90 deg. Elbow



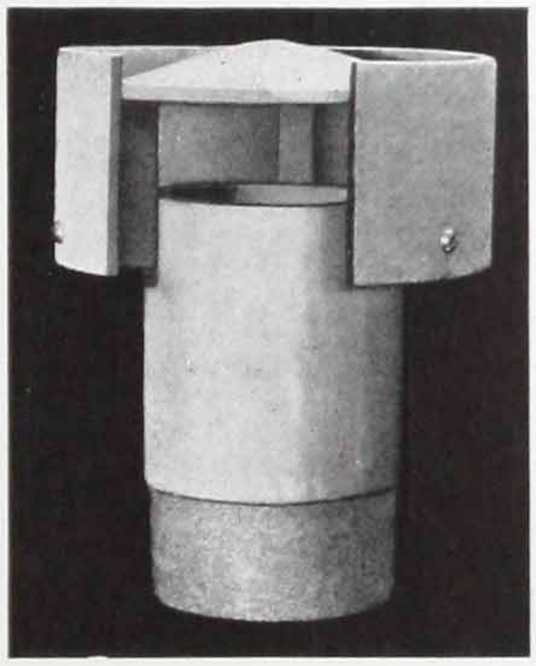
45 deg. Elbow



Duplex Coupling

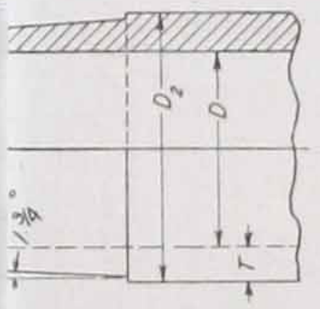


Lateral



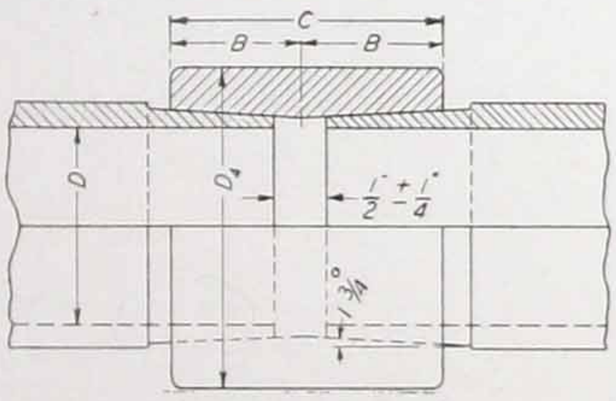
Ventilator Top

Short-leg Tee

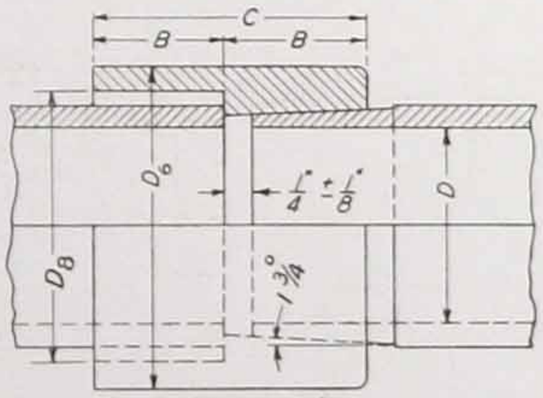


TAPERED FLUE PIPE

PIPE SIZE D	T	D_2
IN.	IN.	IN.
2	.30	2.60
2-1/2	.30	3.10
3	.32	3.64
3-1/2	.32	4.14
4	.32	4.64
4-1/2	.35	5.20
5	.35	5.70
6	.35	6.70
7	.40	7.80
8	.40	8.80
10	.40	10.80
12	.45	12.90

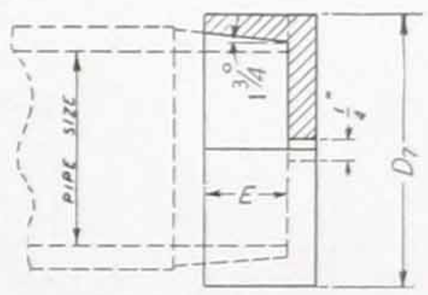


TAPERED COUPLING



DUPLEX COUPLING

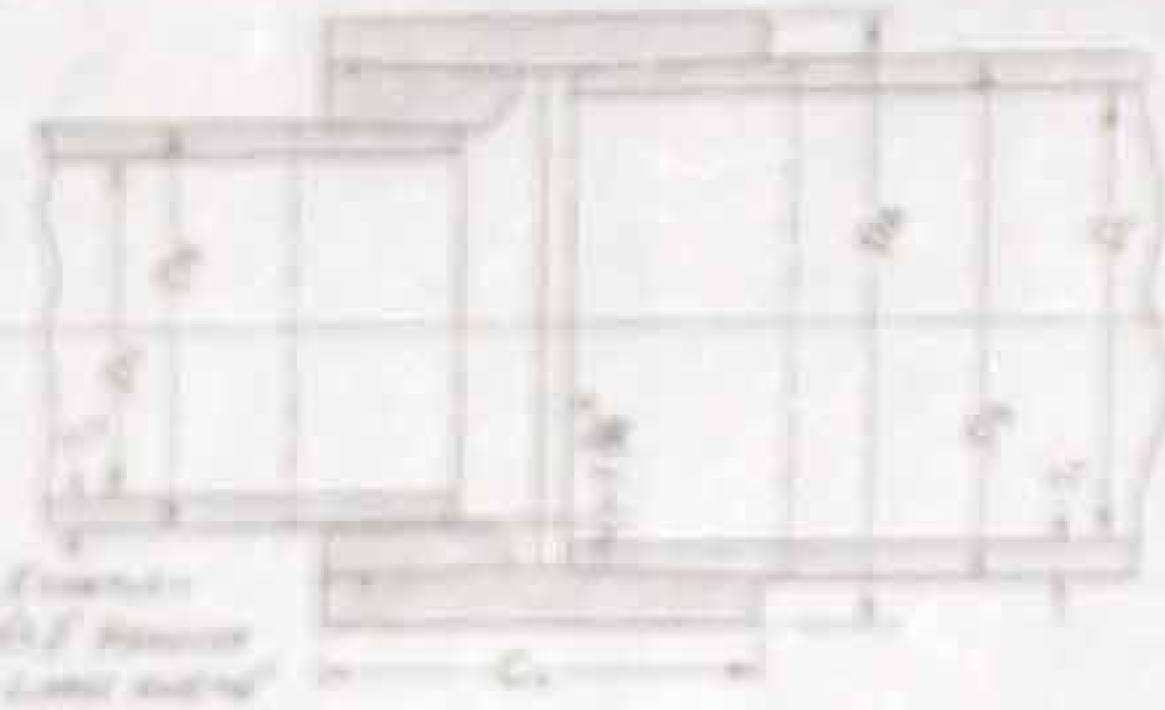
PIPE SIZE D	D_4	B	C	D_6	D_8
IN.	IN.	IN.	IN.	IN.	IN.
2	3.33	1.75	3.5	3.61	2.97
2-1/2	3.83	1.75	3.5	4.11	3.47
3	4.40	1.75	3.5	4.69	4.01
3-1/2	4.92	1.75	3.5	5.19	4.51
4	5.42	2.00	4.0	5.69	5.01
4-1/2	6.06	2.00	4.0	6.33	5.57
5	6.56	2.00	4.0	6.83	6.07
6	7.56	2.00	4.0	7.83	7.07
7	8.78	2.50	5.0	9.05	8.17
8	9.78	2.50	5.0	10.05	9.17
10	11.78	2.50	5.0	12.05	11.17
12	14.01	3.00	6.0	14.27	13.27



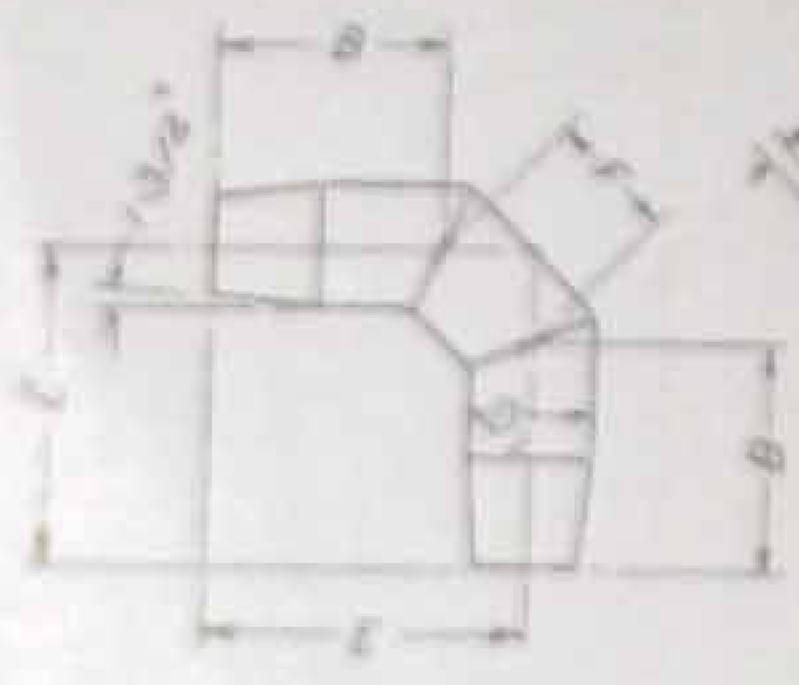
DRIP CAP

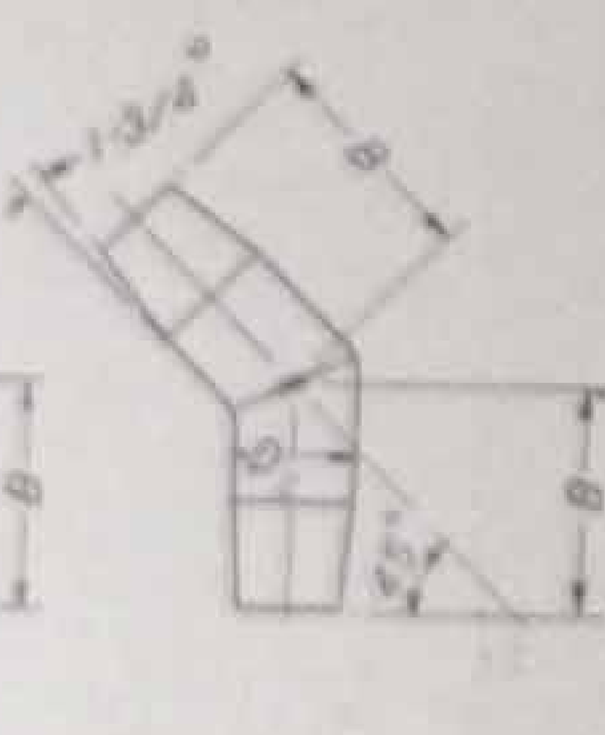
PIPE SIZE	D_7	E
IN.	IN.	IN.
2	3.09	1.5
2-1/2	3.59	1.5
3	4.17	1.5
3-1/2	4.67	1.5
4	5.16	1.5
4-1/2	5.78	1.5
5	6.28	1.5
6	7.28	1.5
7	8.45	1.5
8	9.45	1.5
10	11.45	1.5
12	13.62	1.5

Round Transite Flue Pipe, Fittings and Couplings (continued)

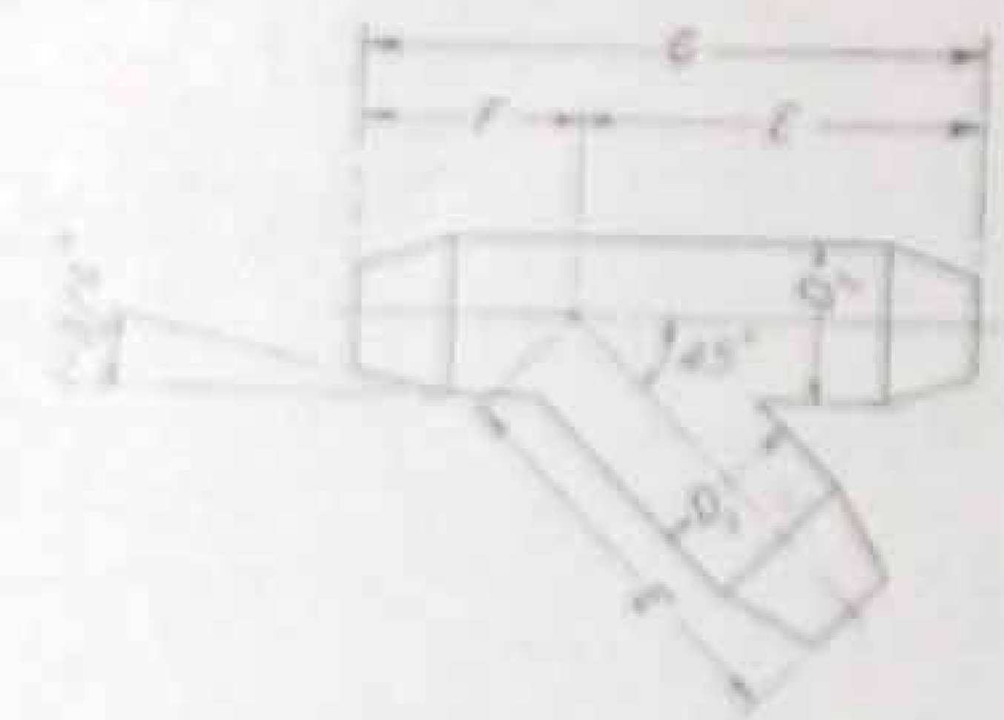


Pipe Size	T	C_1	D_2	D_4
In.	In.	In.	In.	In.
2	.30	3.50	2.60	3.03
2-1/2	.30	3.50	3.10	3.83
3	.32	3.50	3.64	4.40
3-1/2	.32	3.75	4.14	4.82
4	.33	4.00	4.64	5.42
4-1/2	.33	4.00	5.20	6.00
5	.35	4.00	5.70	6.36
6	.38	4.00	6.70	7.52
7	.40	3.00	7.80	8.78
8	.40	3.00	8.80	9.78
10	.40	3.00	10.80	11.78
12	.43	3.50	12.90	14.01



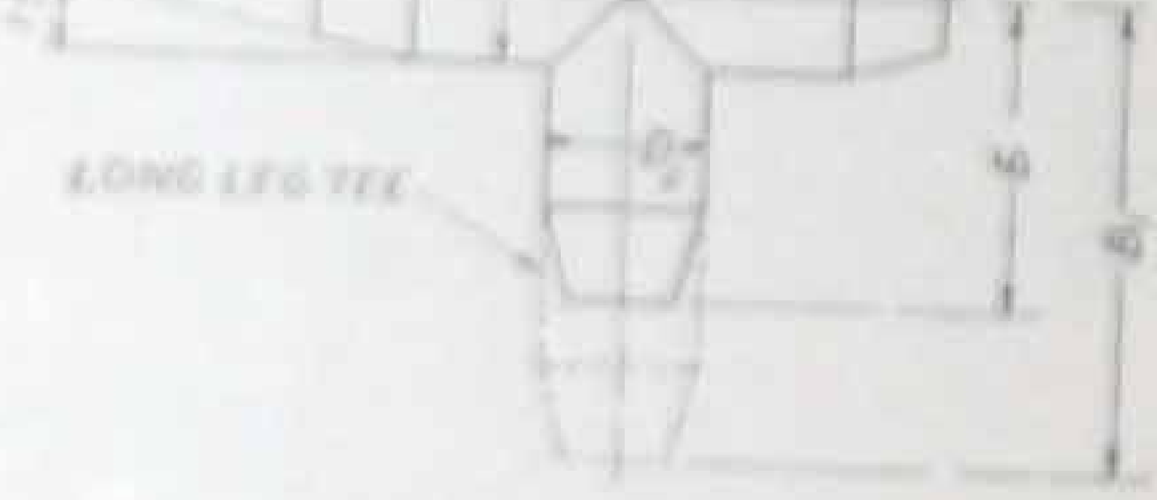


PIPE SIZE	B	D_2	E
In.	In.	In.	In.
2	4.00	2.60	5.41
2-1/2	4.00	3.10	5.77
3	4.50	3.64	6.62
3-1/2	4.50	4.14	6.98
4	5.00	4.64	7.83
4-1/2	5.00	5.20	8.18
5	5.00	5.70	8.50
6	5.25	6.70	9.49
7	6.50	7.80	11.45
8	6.75	8.80	12.41
10	7.25	10.80	14.32
12	8.50	12.90	16.99



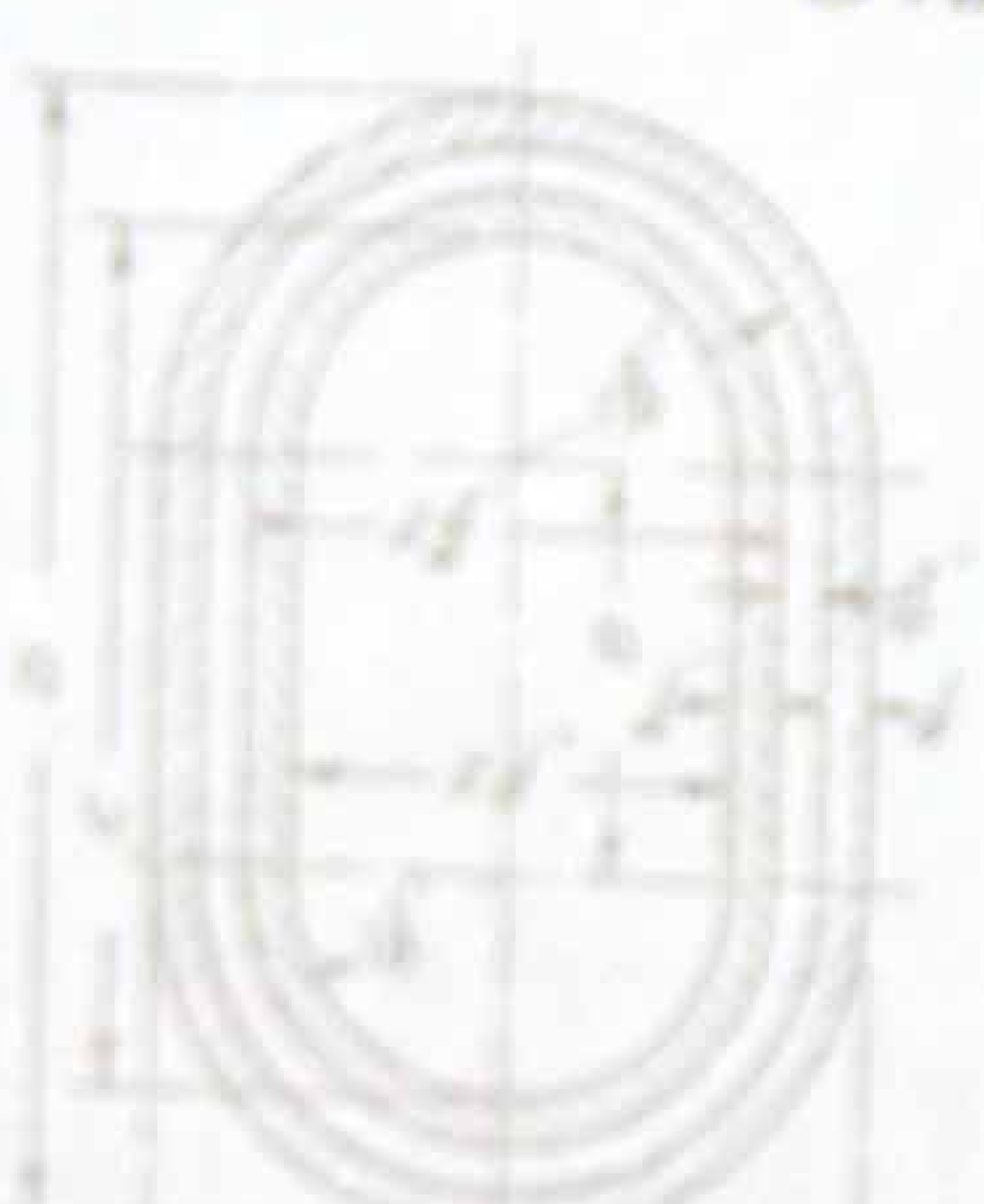
PIPE SIZE	D_2	E	F
In.	In.	In.	In.
2	2.60	8.0	4.25
2-1/2	3.10	9.5	4.25
3	3.64	10.0	4.75
3-1/2	4.14	11.5	4.75
4	4.64	12.0	5.00
4-1/2	5.20	12.5	5.00
5	5.70	13.5	5.50
6	6.70	14.5	5.50
7	7.80	16.5	6.50
8	8.80	17.5	7.00
10	10.80	20.5	7.50
12	12.90	24.5	8.50

PIPE SIZE D	B	C
In.	In.	In.
2	4	4
2-1/2	5	5
3	6	6
3-1/2	7	7
4	8	8
4-1/2	9	9
5	10	10
6	12	12
7	14	12
8	16	12
10	20	12
12	24	12

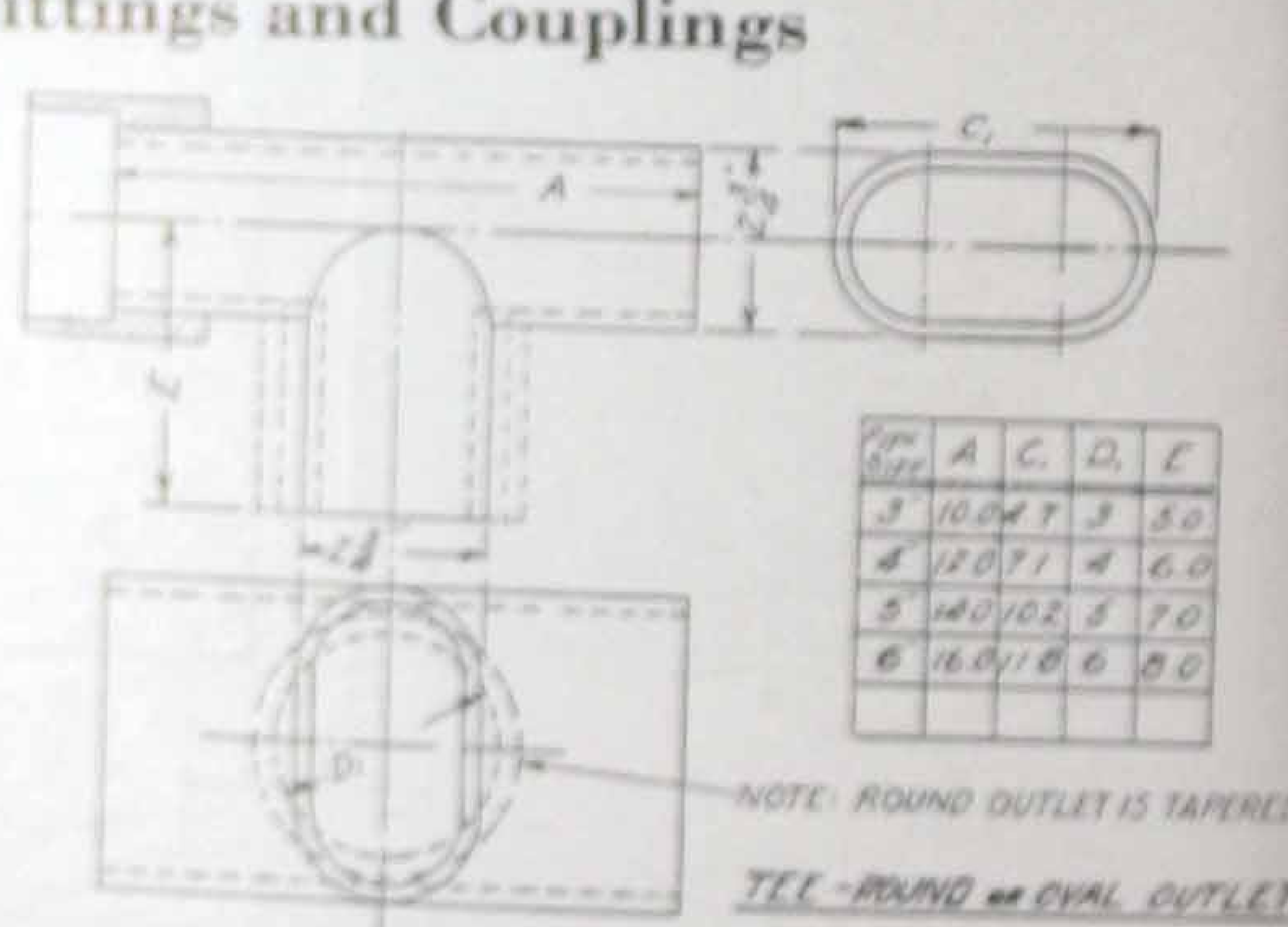


PIPE SIZE	A	B	D_2
In.	In.	In.	In.
2	9	4.5	2.60
2-1/2	10	5.0	3.10
3	11	5.5	3.64
3-1/2	12	6.0	4.14
4	13	6.5	4.64
4-1/2	14	7.0	5.20
5	15	7.5	5.70
6	16	8.0	6.70
7	17	8.5	7.80
8	18	9.0	8.80
10	22	11.0	10.80
12	24	12.0	12.90

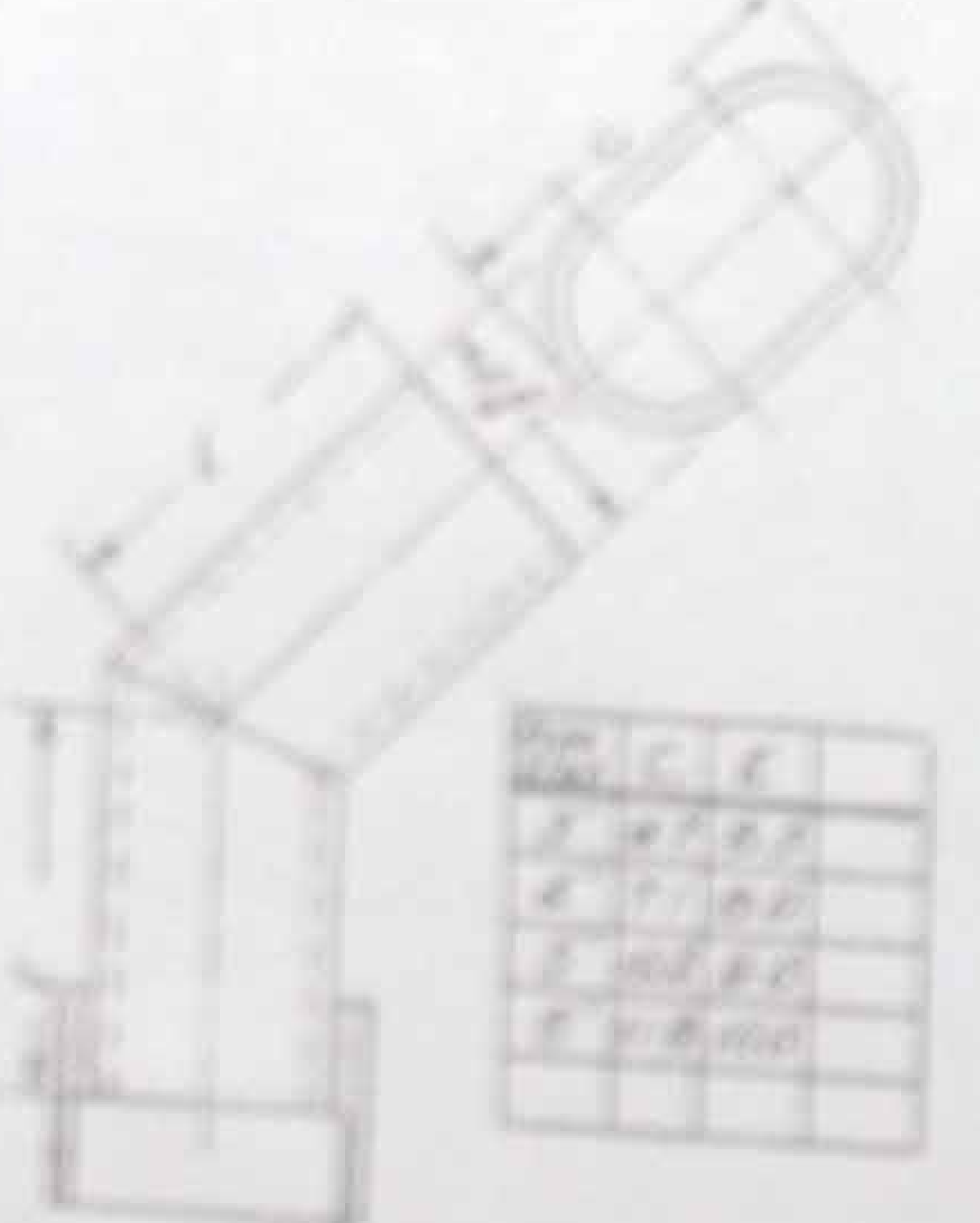
Oval Transite Flue Pipe, Fittings and Couplings



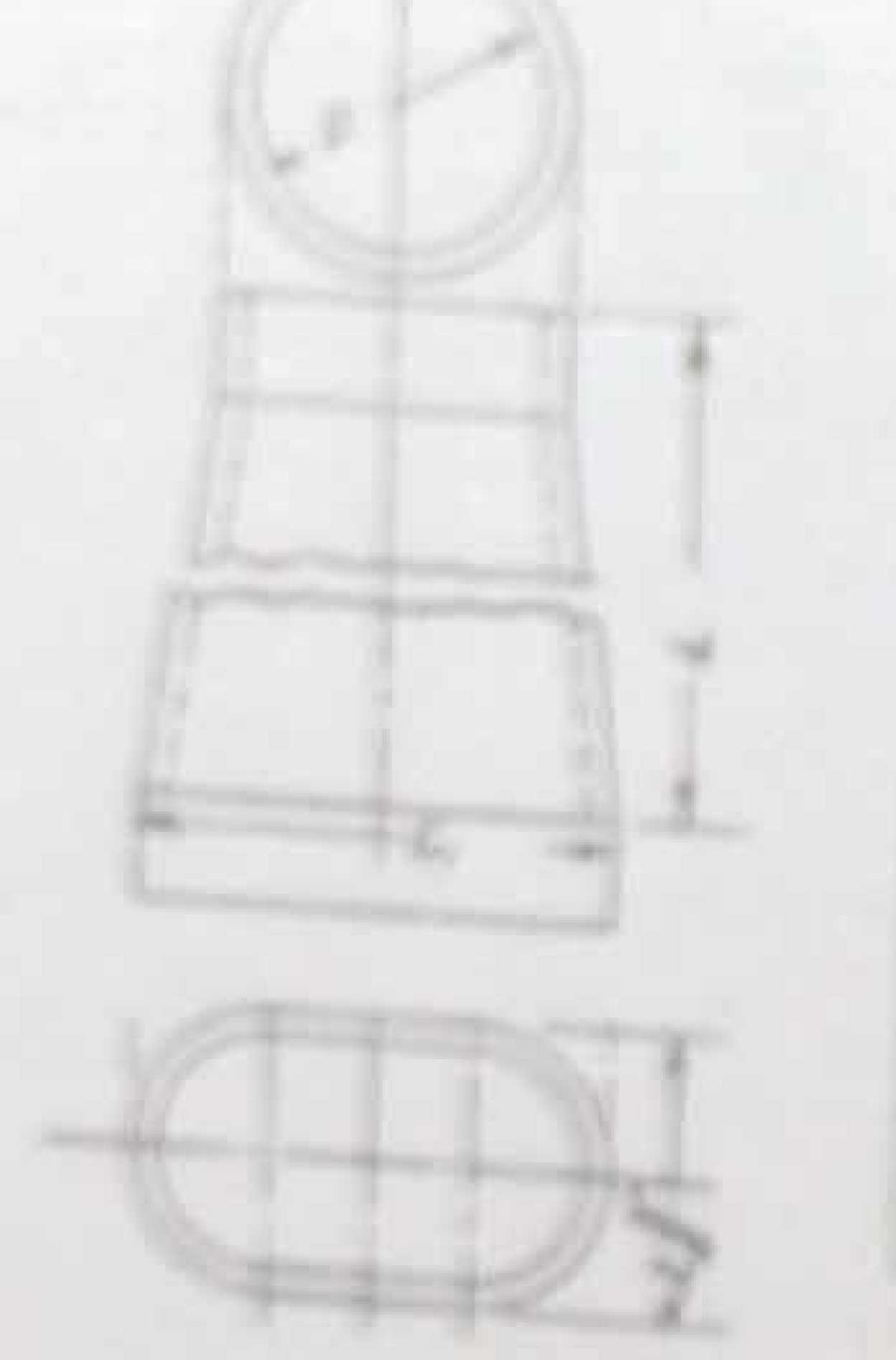
Pipe Size	B	C	D	Oval Area	Round Area	Ratio
3	[illegible]	[illegible]	[illegible]	8.40	7.07	1.19
4	[illegible]	[illegible]	[illegible]	13.8	12.6	1.10
5	[illegible]	[illegible]	[illegible]	20.8	19.6	1.06
6	[illegible]	[illegible]	[illegible]	24.8	28.3	.88



Pipe Size	A	C_1	D_1	E
3"	10.0	4.7	3	5.0
4"	12.0	7.1	4	6.0
5"	14.0	10.2	5	7.0
6	16.0	11.8	6	8.0



Pipe Size	C_1	E	
3	4.7	[illegible]	
4	7.1	[illegible]	
5	10.2	[illegible]	
6	11.8	10.0	



Pipe Size	C_1	D	L
3"	4.7	3"	10.0
4"	7.1	4"	12.0
5"	10.2	5"	14.0
6"	11.8	6"	16.0

Pipe Size	C_1	E	F	
3"	4.7	6.5	7.87	
4	7.1	8.0	9.37	
5	10.2	9.0	10.37	
6"	11.8	10.0	11.37	

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Transite Pressure Pipe

: lines in water transportation service must not e inherently permanent, but must also be water- nd require little maintenance. If true efficiency e attained, low pumping costs must be assured.

nsite Pressure Pipe, manufactured by a unique s from asbestos and cement, affords important tages in this connection. Transite is strong, le and highly resistant to destructive agencies. non-metallic, it is entirely unaffected by electro- action and will not support tubercles. It is resistant to the attack of corrosive soils.

outsanding economy of a pipe line over a per- years is best determined by its carrying capa- or it is no longer accepted that an installation nomical simply because it is structurally intact many years of service. The enormous toll in ine maintenance charges exacted each year by ulation, electrolysis and soil corrosion is now nown. The smooth interior surface of Transite minimum resistance to the flow of water, and, se of its immunity to tuberculation, the original carrying capacity (Williams & Hazen coefficient 0) is retained indefinitely. These character- assure high delivery with low pumping cost ghout the life of the installation. The immun- the material to electrolysis and its high resistance destructive effects of corrosive soils have induced

Transite water mains are highly resistant to corrosion and unaffected by tuberculation and electrolysis

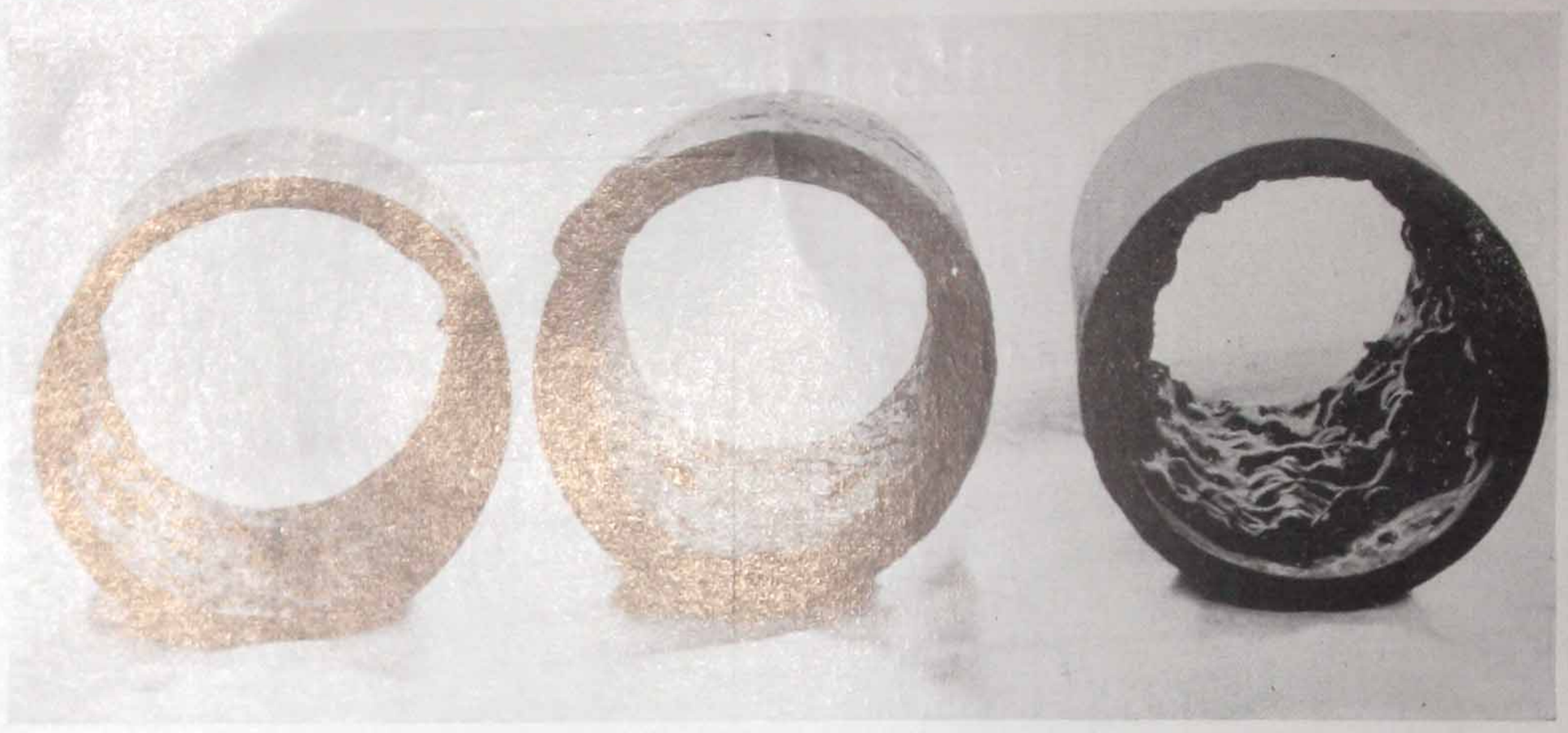
its adoption for severe service conditions in all parts of the United States and Canada.

Though strong and dense, the pipe is relatively light in weight, a characteristic which makes for economical installation. Small crews may be used, often to the exclusion of mechanical equipment. The Simplex Couplings, consisting of a Transite sleeve and

Dimensions and Approximate Weights of Transite Pressure Pipe*

Class 50 For heads of 115 ft. of water				Class 100 For heads of 231 ft. of water				Class 150 For heads of 346 ft. of water				Class 200 For heads of 462 ft. of water			
Thickness, inches	Outside Diameter, inches	Weight, lb. per lin. ft. Pipe Only	Weight, lb. per lin. ft. Incl. Coup.	Thickness, inches	Outside Diameter, inches	Weight, lb. per lin. ft. Pipe Only	Weight, lb. per lin. ft. Incl. Coup.	Thickness, inches	Outside Diameter, inches	Weight, lb. per lin. ft. Pipe Only	Weight, lb. per lin. ft. Incl. Coup.	Thickness, inches	Outside Diameter, inches	Weight, lb. per lin. ft. Pipe Only	Weight, lb. per lin. ft. Incl. Coup.
.34	2.68	2.3	2.8	.41	2.82	2.8	3.4	.46	2.92	3.3	3.8	.50	3.00	3.6	4.1
.34	3.18	2.8	3.4	.41	3.32	3.5	4.1	.46	3.42	3.9	4.5	.50	3.50	4.2	4.8
.36	3.72	3.5	4.1	.44	3.88	4.3	5.0	.49	3.98	4.8	5.6	.53	4.06	5.3	6.0
.36	4.22	4.0	4.6	.44	4.38	4.9	5.8	.49	4.48	5.5	6.3	.53	4.56	6.0	6.8
.33	4.66	4.7	5.3	.48	4.96	6.8	7.5	.53	5.06	7.2	7.9	.60	5.20	8.3	9.1
.34	5.18	5.4	5.9	.49	5.48	7.8	8.4	.55	5.60	8.4	9.1	.64	5.78	9.9	10.7
.35	5.70	6.2	6.8	.50	6.00	8.8	9.6	.57	6.14	9.6	10.4	.68	6.36	11.6	12.5
.36	6.72	7.5	8.2	.51	7.02	10.6	11.4	.62	7.24	12.5	13.4	.75	7.50	15.4	16.6
.38	7.76	9.2	10.6	.52	8.04	12.5	13.4	.66	8.32	15.2	16.3	.83	8.66	20.1	21.4
.42	8.84	11.6	12.4	.52	9.04	14.2	15.3	.69	9.38	18.0	19.1	.91	9.82	24.9	26.4
.44	10.88	15.1	16.2	.59	11.18	20.0	21.2	.85	11.70	27.9	29.6	1.10	12.20	37.1	39.3
.48	12.96	19.6	20.9	.68	13.36	27.4	29.0	.98	13.96	38.2	40.4	1.24	14.48	49.6	52.6
.52	15.04	24.7	26.5	.78	15.56	35.9	38.3	1.13	16.26	51.3	54.6	1.44	16.88	66.8	71.4
.56	17.12	30.3	32.4	.88	17.76	47.3	50.3	1.25	18.50	64.7	68.9	1.65	19.30	86.9	92.7
.59	19.18	35.8	38.2	.97	19.94	58.9	62.6	1.39	20.78	80.9	86.0	1.87	21.74	110.5	117.6
.63	21.26	42.4	45.3	1.07	22.14	71.8	76.3	1.53	23.06	99.1	105.4	2.09	24.18	136.8	146.0
.69	25.38	55.9	60.0	1.25	26.50	100.3	107.3	1.82	27.64	141.2	151.2	2.48	28.96	195.4	208.8
.90	31.80	88.8	95.8	1.54	33.08	146.9	160.2	2.29	34.58	220.3	239.5	3.12	36.24	305.3	327.4
1.09	38.18	124.3	134.0	1.83	39.66	205.3	224.1	2.80	41.60	319.3	346.5	3.74	43.48	434.9	468.5

Based upon machined section of pipe which extends from each end as follows: 2" to 12" dia. inc., 15"; 14" to 20" dia. inc., 17"; ., 19"; 30" and 36" dia., 21".



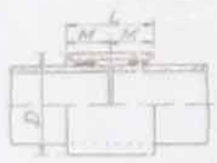
Sections of metal pipe, showing effect of tuberculation

two rubber rings, also effect installation economies and insure tight, yet flexible, joints. The couplings require no caulking and may be readily assembled by unskilled labor. With this coupling the line may be deflected at curves without the use of special fittings.

Transite Pressure Pipe is manufactured in four pressure classes, designated as 50, 100, 150 and 200, which numbers indicate the working pressures in lb. per sq. in. The pipe is furnished in standard sizes from 2" to 36" diameter, inclusive. Standard lengths are 10 ft. for sizes 2" to 3½" and 13 ft. for sizes 4" to 36". Half-lengths can be supplied on special order. Pipe is furnished with plain ends, the outside surfaces of which are machined to receive the Simplex Couplings.

The Underwriters' Laboratories, as a result of tests on sizes 4" to 24" of Class 150 Transite Pressure Pipe, have listed this class, with couplings, for underground service carrying presures up to that corresponding to the class designation. The Underwriters do not list pipe of lesser rating. State and municipal authorities generally have approved Transite, and pipe installations of years ago fortify these laboratory findings with practical evidence of satisfactory service.

The accompanying tables provide information on pipe, fittings and couplings. Inside diameters represent full flow areas; no deductions need be made.



Dimensions of Simplex Joints

Pipe Size, inches	Class 50			Class 100			Class 150			Class 200		
	L, in.	M, in.	D, in.	L, in.	M, in.	D, in.	L, in.	M, in.	D, in.	L, in.	M, in.	D, in.
2	7	3.5	4.65	7	3.5	5.01	7	3.5	5.13	7	3.5	5.
2½	7	3.5	5.15	7	3.5	5.51	7	3.5	5.63	7	3.5	5.
3	7	3.5	5.69	7	3.5	6.07	7	3.5	6.19	7	3.5	6.
3½	7	3.5	6.19	7	3.5	6.57	7	3.5	6.69	7	3.5	6.
4	7	3.5	6.46	7	3.5	7.11	7	3.5	7.35	7	3.5	7.
4½	7	3.5	7.02	7	3.5	7.63	7	3.5	7.90	7	3.5	8.
5	7	3.5	7.56	7	3.5	8.15	7	3.5	8.43	7	3.5	8.
6	7	3.5	8.60	7	3.5	9.19	7	3.5	9.53	7	3.5	9.
7	7	3.5	9.66	7	3.5	10.21	7	3.5	10.67	7	3.5	11.
8	7	3.5	10.76	7	3.5	11.23	7	3.5	11.77	7	3.5	12.
10	7	3.5	12.84	7	3.5	13.41	7	3.5	14.31	7	3.5	15.
12	7	3.5	14.96	7	3.5	15.61	7	3.5	16.87	7	3.5	17.
14	8	4.0	17.20	8	4.0	18.18	8	4.0	19.64	8	4.0	20.
16	8	4.0	19.34	8	4.0	20.58	8	4.0	22.16	8	4.0	23.
18	8	4.0	21.44	8	4.0	23.00	8	4.0	24.78	8	4.0	26.
20	8	4.0	23.58	8	4.0	25.44	8	4.0	27.40	8	4.0	29.
24	9	4.5	28.04	9	4.5	30.38	9	4.5	32.78	9	4.5	34.
30	10	5.0	35.00	10	5.0	37.98	10	5.0	41.12	10	5.0	43.
36	10	5.0	41.78	10	5.0	45.36	10	5.0	49.24	10	5.0	51.

Standard cast iron fittings that fit Transite Pipe

Pipe Size, inches	Class 50		Class 100		Class 150		Class 200	
	Class Fitting	Joint Clearance	Class Fitting	Joint Clearance	Class Fitting	Joint Clearance	Class Fitting	Joint Clearance
4	D	.52	D	.37	D	.32	D	.25
6	D	.54	D	.39	D	.28	Special Bell	
8	D	.58	D	.48	D	.31	"	
10	D	.61	D	.46	Special Bell		"	
12	D	.62	D	.42	"		"	
14	B	.48	D	.44	"		"	
16	B	.64	D	.52	"		"	
18	B	.66	D	.49	"		"	
20	B	.67	D	.46	"		"	
24	B	.71	D	.41	"		"	
30	B	.62	D	.33	"		"	
36	B	.56	D	.25	"		"	

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CCA

ELECTRICAL

PACKINGS

REFRACTORY CEMENTS

TRANSITE ELECTRICAL

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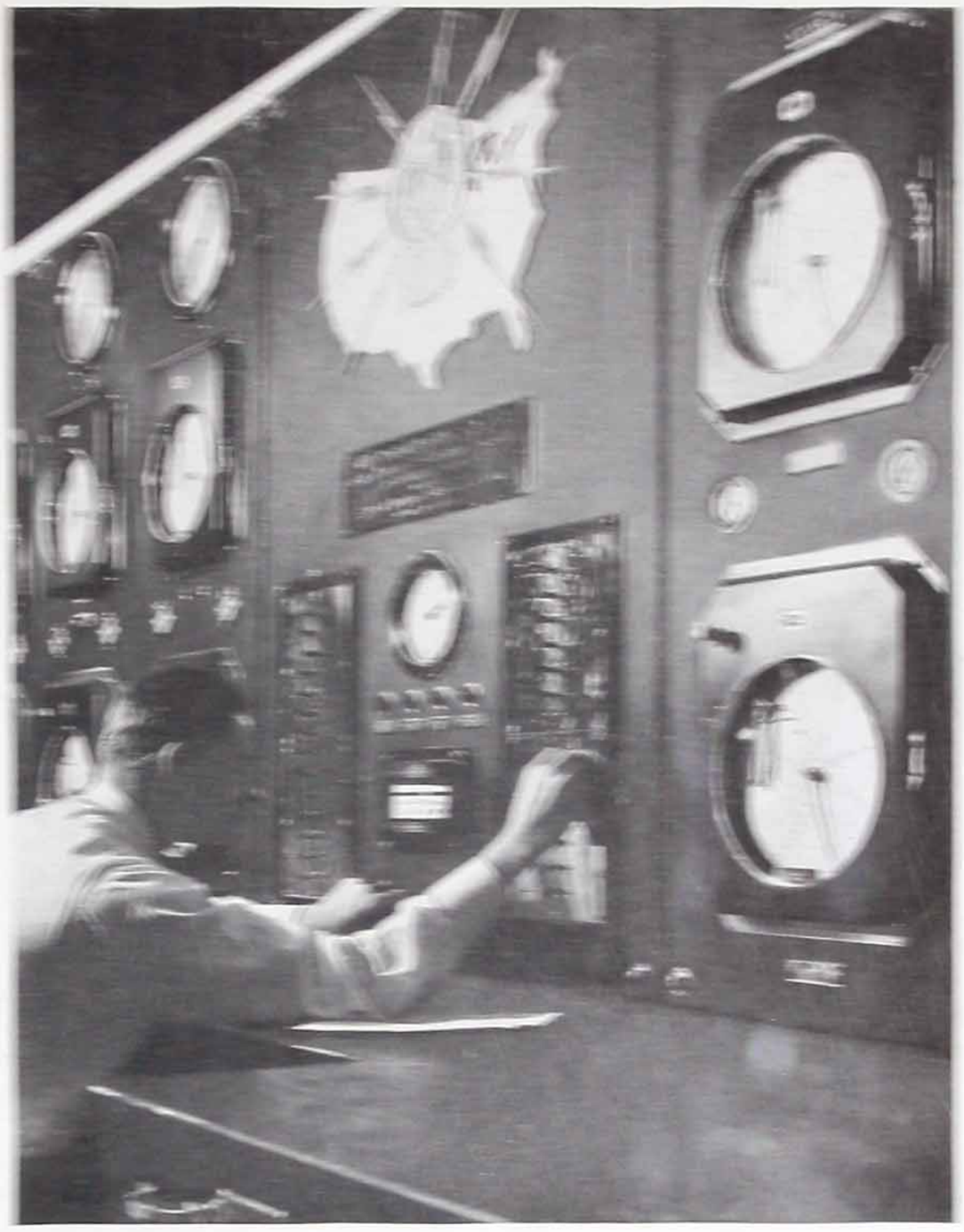
API INTERNATIONAL

CCA

Asbestos Ebony

Asbestos Ebony is an ideal electrical insulation. -like in appearance, which is employed for switchboards, controller plates, switch bases, bus-bar orts, etc. It is purely a mineral product, composed of asbestos fibre and binding cement, bonded tremendous pressure, impregnated with a special insulating compound, and capable of enduring e conditions. Because of its structure, it will stand shock and vibration, is unaffected by rapid erature changes, will not shrink, crack or buckle, s uniform in texture throughout. It is extremely ble, actually becoming stronger with age.

Asbestos Ebony has a specific gravity of about and weighs approximately 123 lb. per cu. ft. safe working temperature limit of Asbestos Ebony out 300 deg. F.



Asbestos Ebony control board for the air-conditioning system of the N.B.C. Studio Building, New York, N. Y.

dvantages of J-M Asbestos Ebony

igh Dielectric Strength and Insulation Resis-: The dielectric strength of Asbestos Ebony, 1" is 52,500 volts, and its D. C. insulation resis- is 4,000,000 megohms per inch cube. High di- ric strength and insulation resistance are assured l times because of its absolute uniformity.

mmunity to Moisture:- Asbestos Ebony may be y relied upon as an ideal insulator in damp loca- s. After six hours of sea water immersion, fol- d by rinsing, a drying period of eighteen hours six hours of exposure to steam vapor, megger ings on either side average 220 megohms. The ited States Navy specifies that a material which s a reading of 25 megohms after such exposure ceptable for use on naval vessels. The superior lating qualities of Johns-Manville Asbestos Ebony herefore immediately apparent.

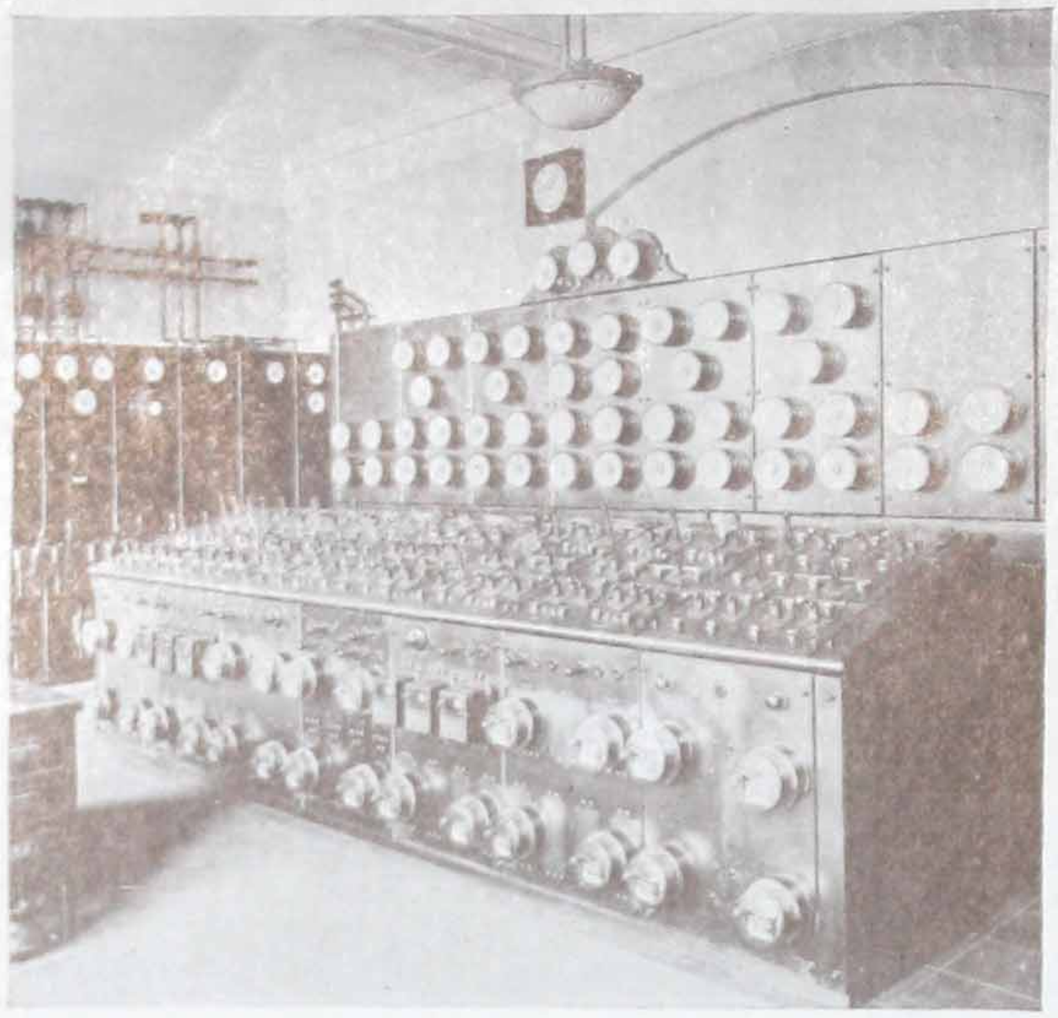
ight Weight:- The relatively light weight of As- s Ebony compared with other materials for sim- purposes not only results in lower transportation handling costs but also in many cases will permit ighter framework.

Workability:- The machining operations necessary repare Asbestos Ebony for erection or assembly rapidly and easily accomplished. Drilling, ma- ing, etc., are executed without the breakage that ds such operations when performed on more brit- materials. Detailed instructions for machining, ling, finishing, etc., will be furnished on request.

Strength and Durability:- Asbestos Ebony in the standard thicknesses regularly utilized in electrical construction, combines a generous margin of safety in tension or compression with the ability to withstand shock and vibration that is inherent in a fibrous material. The practical demonstration of this faculty is found in the use of Asbestos Ebony aboard U. S. Naval vessels, where the shock of broadside firing must be absorbed without cracking or fracture. Also, the opening and closing of heavy automatic switches, relays, and circuit breakers often occur in a manner that communicates the resultant vibrations either directly or indirectly to Ebony panels and bases.

Asbestos Ebony is comparatively light, but it is dense, uniform, monolithic. There are no laminations and it will not shrink, crack, warp or buckle under severe service conditions.

Asbestos Ebony is a permanent material. It will not rust, nor is it subject to rot or decay. It remains uninjured after exposure to water, oil, gas and ordinary chemicals. Sudden temperature changes, en-



Asbestos Ebony meter board at Bureau of Power and Light, Dept. of Public Service, City of Los Angeles, Cal.

countered in electrical work by reason of arcs or flash-overs, do not result in ruptures such as often occur in more brittle materials. Asbestos Ebony actually grows stronger and tougher with age.

Asbestos Ebony is regularly manufactured at Nashua, N. H. Emergency orders for Western points can be readily supplied from Waukegan, Ill., at slight additional cost. Ebony is also stocked by many panel fabricators throughout the country, who offer prompt and efficient service. Any Johns-Manville office will provide shipping information.

Finishes

J-M Asbestos Ebony is supplied in two finishes:

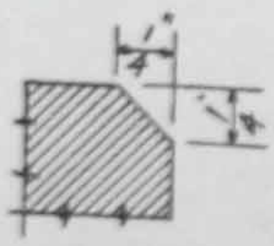
Standard finish—on material of 1/8″ or 3/16″ thickness—is a deep, everlasting black.

Switchboard finish—on material of ¼″ to 4″ thickness, inclusive—is a finer, smoother surface than Standard finish, in the same deep, everlasting black.

While Asbestos Ebony is regularly finished in lacquer, all thicknesses can be furnished unlacquered.

Bevels

Any desired bevel may be furnished but bevels are usually ⅛″, ¼″, ⅜″, or ½″, with ¼″ the most popular. Bevels are measured as per sketch; thus a ¼″ bevel would have a projected measurement across face of panel of ¼″ and ¼″ down edge.



Sizes and Weights

Thickness,* inches	Sheet Sizes,† inches	Approximate Weig lb. per sq. ft. Uncrated	Crat
⅛	36 x 48 only	1.3	1.5
3/16	"	1.9	2.2
¼	36 x 48, 42 x 48 and 42 x 96	2.5	3.0
5/16	" " "	3.3	3.8
⅜	" " "	4.2	4.8
½	" " "	5.0	5.9
⅝	" " "	6.3	7.5
¾	" " "	7.5	8.7
⅞	" " "	8.7	10.0
1	" " "	10.0	12.0
1¼	" " "	12.5	15.0
1½	" " "	15.0	18.0
1¾	" " "	17.5	21.0
2	" " "	20.0	24.0
2½	" " "	25.0	30.0
3	" " "	30.0	35.0
3½	" " "	35.0	40.0
4	" " "	40.0	45.0

* All Asbestos Ebony is furnished ± 1/64″ on thickness.

† Standard uncut sheets measure a fraction of an inch larg than nominal sizes given.

Cut panels can be furnished within the size limitations standard sheets. The tolerance allowed is ± 1/32″ on lengt and width. Holes can be drilled to an accuracy of ± 1/32 Where jigs are furnished an accuracy of ± 1/64″ is possibl

Asbestos Ebony Accessories

Asbestos Ebony Filler Compound:

Asbestos Ebony Filler Compound is a putty glaz for treating Asbestos Ebony surfaces which have bee marred or scratched slightly. It is applied with putty knife, fine sanded and lacquered. Furnished i 1-gallon and 5-gallon cans.

Asbestos Ebony Filler Wax:

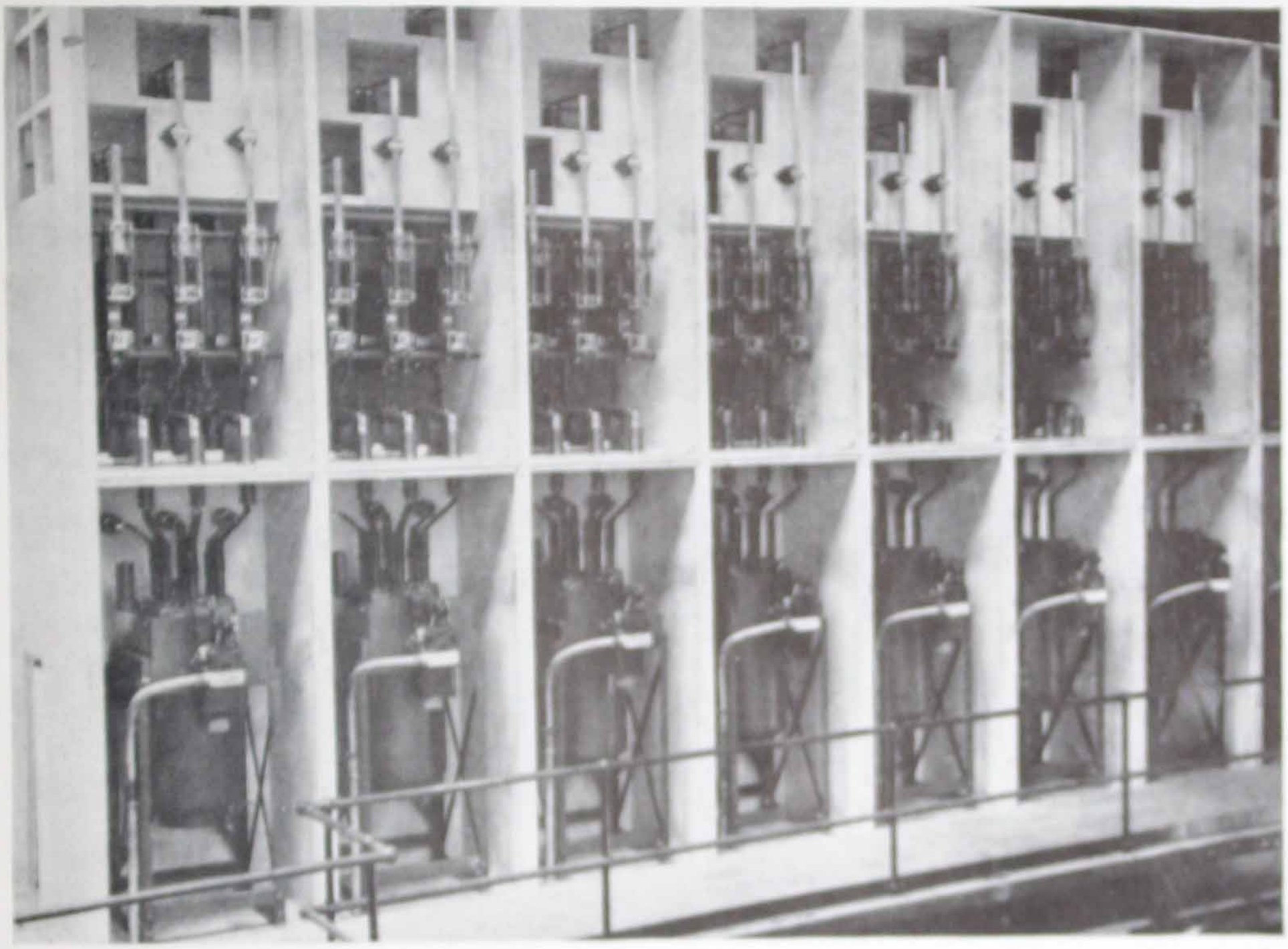
This material is used for filling deep pits, gouge or erroneous drillings. It is furnished in sticks an used much after the manner of sealing wax. Firs it is melted into the cavity and the excess scraped of to slightly below the panel surface. Then a glazing o Asbestos Ebony Filler Compound is applied and the rough spot fine sanded and lacquered.

In the case of a sizable hole drilled through a thick panel, it is sometimes desirable to turn down an Asbestos Ebony plug to fill the opening, finishing up with a fine sanding, Filler Compound and Lacquer.

Asbestos Ebony Lacquer:

This material is used for lacquering Asbestos Ebony panels in the field. Lacquer and thinner are shipped separately to be mixed as required. Application should be made with spraying equipment. The covering capacity of the lacquer is about 300 sq. ft. per gallon. Lacquer and thinner are furnished in quart and gallon cans.

J-M Trancell Materials for housing electrical equipment



J-M Trancell Materials are compact, light in weight and easy to erect. Note the facility with which the above bus structures are accommodated

Cell structures must do more than provide a satisfactory means for installing electrical equipment such as bus bars, transformers, disconnect switches and other fairly high voltage apparatus. They must safeguard the station operators and prevent accidental contacts between phases, circuits or ground, as well as confine within restricted spaces the products of combustion or ionized gases which are generated by fire or electric arc.

Sufficient strength is necessary in order to support the equipment and withstand the electrical stresses. Workability is essential to permit field cutting, drilling and bolting without injury to the structure. Extensions must be readily effected and repairs easily made when damage occurs.

The above are absolute requirements. In addition, the barriers and shelves should be strong and of minimum thickness in order to conserve space. Light weight is desirable to decrease floor loading. Construction should be simple to reduce fabricating costs and the expense of field erection.

Trancell materials embody all of these advantages and permit ready combination with other products, such as concrete or metal, where extremely heavy loads are encountered. This is sometimes the case with housings for reactors and oil circuit breakers where parts of the structure form load bearing walls for carrying floors.

The usual cell structures which are self-supporting and independent from concrete walls do not require reinforcement but housings for large circuit breakers and heavy trip mechanisms generally need steel framing. In the case of large reactors where heavy stresses are set up on short circuits, reinforcing, constructed of

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non-magnetic metals, should be used. For this work, rolled shapes of aluminum alloy having about the same tensile strength as structural steel are used. Shapes, such as I's, channels and angles are available.

Bus structures, housings for current and potential transformers, mountings for disconnect switches and protection for cables are easily accommodated by Trancell materials alone, a variety of types and combinations of which are tabulated on the next page.

The segregation and mounting of bus bars have always been difficult and expensive operations. Trancell materials are especially adaptable for this type of service because they conserve space, are light in weight, are comparatively inexpensive and permit the installation of the bus bar support without difficulty. To facilitate inspection, removable Trancell covers can be easily constructed.

The appearance of Trancell products is pleasing and there is no necessity for further treatment but they can be painted to match any color scheme, if desired, by following the manufacturer's directions.

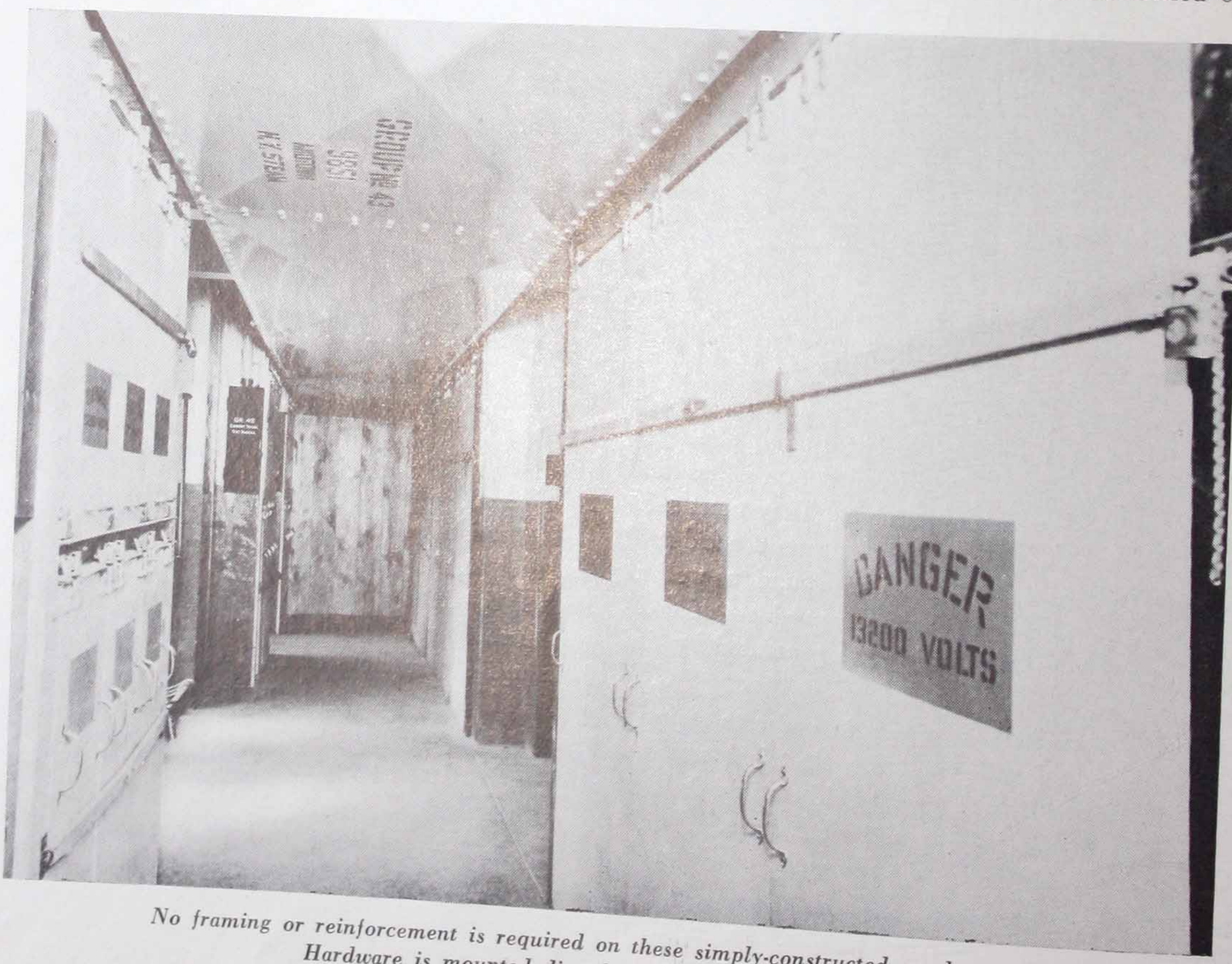
Erection of Trancell Materials

The toughness and resilience of Trancell mat are of great value in building a structure be these products will stand more abuse in handling other materials used for similar service. The size and light weight of the slabs permit rapid tion which is further facilitated by the ease with w the material is cut and drilled.

Even though the design is carefully worked some trimming and cutting is required on the job d general inaccuracies in building construction. Ne is it wise to drill all bolt holes in the shop. Time expense can generally be saved by field drilling.

Drilling in the field can be done with a port electric drill. Cutting can be done with a carpen saw, but a light-weight electric saw does the w more quickly and with less effort. Experience sh that an abrasive disc is best for this class of serv

To assist in field work, detail drawings can be nished. In such cases, key numbers are marked the drawings and the same number stencilled on



No framing or reinforcement is required on these simply-constructed, modern doors. Hardware is mounted directly on the Trancell-M sheets

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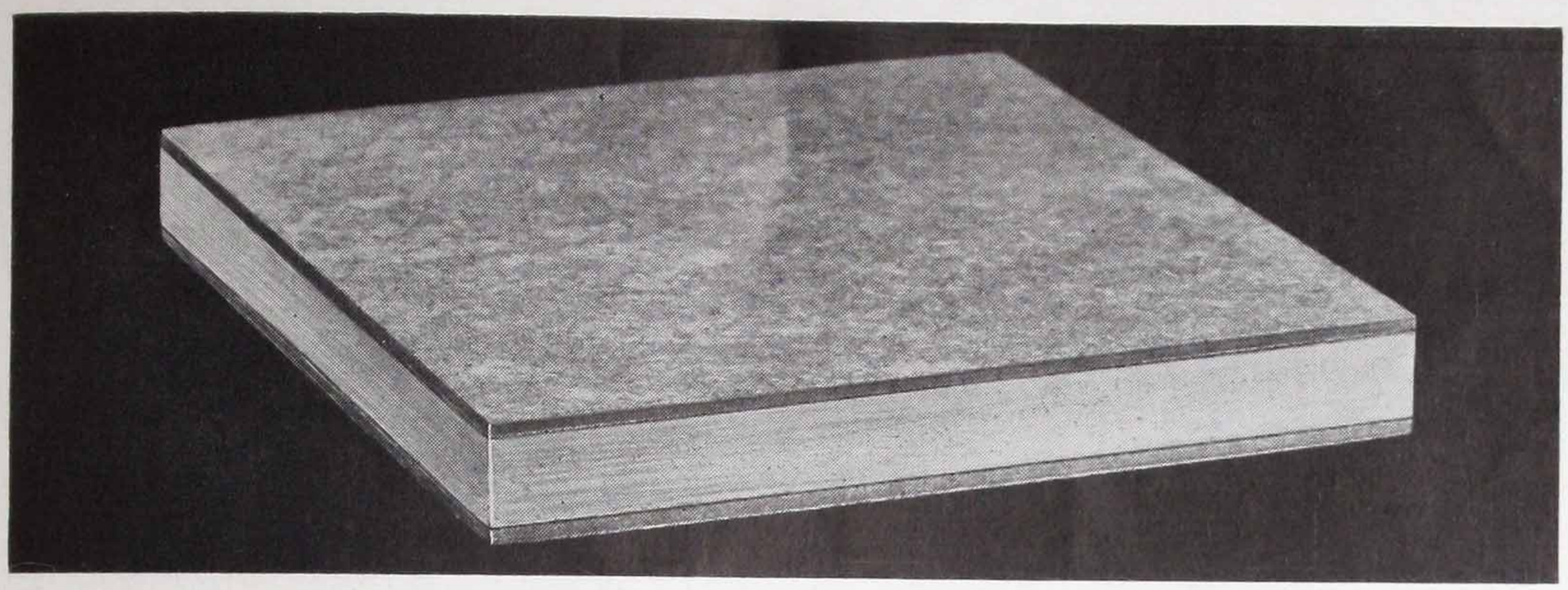

Trancell D, cut from a large sheet, showing on each side the facing of Asbestos Flexboard

materials. All crates are numbered and packing lists supplied showing the material in each crate. This saves considerable time and labor.

Doors: Whatever the material used for constructing the housing, all cell structures require doors which should be light in weight and free from warpage. Doors have generally been fabricated from 1/8″ or 1/4″ Transite panels with stiles and rails of the same material or of fire-resisting wood.

Trancell M is an even better material for cell doors. It is 3/4″ thick, weighs 4.4 lb. per sq. ft. and has less warpage than materials formerly used. Doors made from Trancell M not only have a pleasing appearance but also have remarkable strength. A strip of this material 12″ wide supported on 30″ centers will bear a load of 300 lb.

The former method of manufacturing panel doors with stiles and rails requires much more elaborate shop equipment and a greater degree of skilled labor than the simple sheet doors which may be made from Trancell M. This material, which has been especially designed for the construction of doors, can be readily cut and fabricated with hand tools or with ordinary shop equipment. Hangers and handles are mounted directly on the Trancell-M sheets and there is no need for stiles, rails or metal trim.

Types and Combinations of Trancell Materials

Designation	Description	Size, inches	Overall thickness, inches
Transite	Asbestos fibre and portland cement weighing 124 lb. per cu. ft.	36 x 48, 42 x 48 48 x 48, 42 x 96	1/8, 3/16, 1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2
		36 x 48, 42 x 48	2 1/2, 3, 3 1/2, 4
Trancell A	Asbestos fibre and inorganic binder weighing 78 lb. per cu. ft. Oil dipped and baked; glazed finish	36 x 96, 42 x 96 48 x 96	1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 2
Trancell B	Asbestos fibre and inorganic binder weighing 42.5 lb. per cu. ft. Oil dipped and baked; glazed finish	36 x 96, 42 x 96 48 x 96	1/2, 5/8, 3/4, 7/8, 1
Trancell D	Trancell A with 1/8″ Flexboard sheets cemented to each side. Flexboard is steam cured and sanded	36 x 96, 42 x 96 48 x 96	3/4, 1, 1 1/4, 1 1/2, 1 3/4, 2 1/4
Trancell D-1	Same as Trancell D, except Flexboard is supplied on one side only	36 x 96, 42 x 96 48 x 96	5/8, 7/8, 1 1/8, 1 3/8 1 5/8, 2 1/8
Trancell E	Trancell B with 1/8″ Flexboard sheets cemented to each side. Flexboard is steam cured and sanded	36 x 96, 42 x 96 48 x 96	3/4, 7/8, 1, 1 1/8, 1 1/4
Trancell E-1	Same as Trancell E, except Flexboard is supplied on one side only	36 x 96, 42 x 96 48 x 96	5/8, 3/4, 7/8, 1, 1 1/8
Trancell H	Trancell A with 1/4″ Transite sheets cemented to each side. Transite is steam cured and sanded	36 x 48, 42 x 48 48 x 48, 42 x 96	1 1/2, 1 3/4, 2, 2 1/2
Trancell H-1	Same as Trancell H, except Transite is supplied on one side only	36 x 48, 42 x 48 48 x 48, 42 x 96	1 1/4, 1 1/2, 1 3/4, 2 1/4
Trancell K	Trancell B with 1/4″ Transite sheets cemented to each side. Transite is steam cured and sanded	36 x 48, 42 x 48 48 x 48, 42 x 96	1 1/4, 1 1/2
Trancell K-1	Same as Trancell K, except Transite is supplied on one side only	36 x 48, 42 x 48 48 x 48, 42 x 96	1, 1 1/4
Trancell M	A 1/2″ core of Trancell B with 1/8″ Flexboard cemented to each side. Flexboard is steam cured and sanded. Sides and edges are waterproofed with clear Tornesit lacquer. Weight 4.4 lb. per sq. ft.	36 x 96 42 x 96 48 x 96	3/4

Note: All weights given are approximate.

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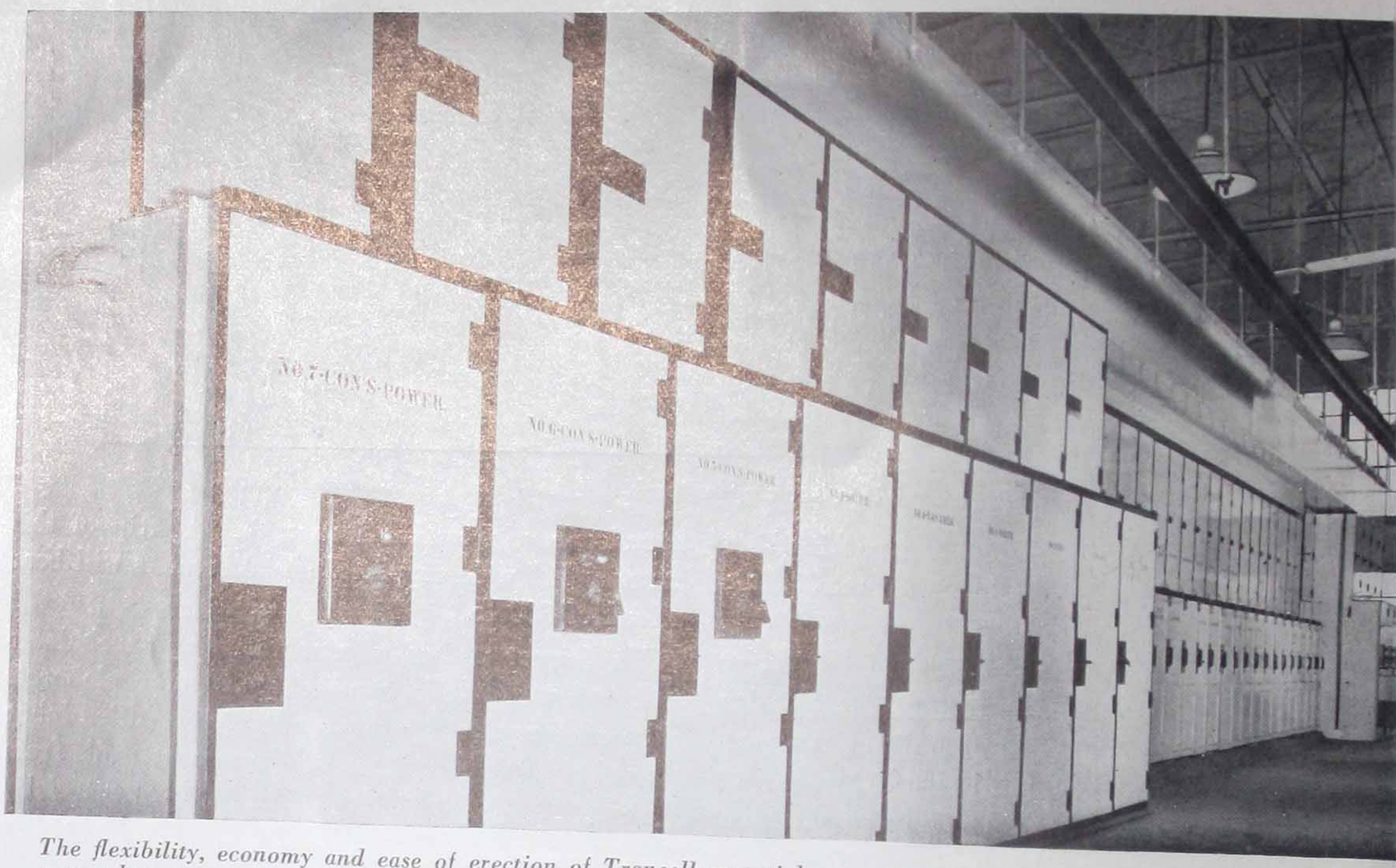

The flexibility, economy and ease of erection of Trancell materials greatly facilitated this difficult job of housing a new bus structure and ties to existing switching apparatus. The use of these materials instead of monolithic structures, cast in place on the job, saved space, reduced skilled-labor costs and minimized working hazards

Trancell Compared with Other Structures

Monolithic cell structures, cast in place on the job, have been much used in recent years but they do not offer the advantages of fabricated units. Monolithic housings have sufficient strength but they are not light in weight, cannot be made in thin cross-sections and are not as easily worked as the various types of J-M Trancell materials.

Four inches is about the minimum practical thickness for cast slabs and the space occupied by such slabs represents a considerable percentage of the floor area taken by the cells. The weight per sq. ft. is about 50 lb., which makes a weight of 1000 lb. for a barrier 2½-ft. wide by 8-ft. high. A similar Trancell barrier could be made of 2″-thick material and weigh only 230 lb. This represents a saving of 50 percent in space and a reduction of 77 percent in weight. Trancell barriers ¾″ thick can be furnished weighing only 2.8 lb. per sq. ft.

Form work necessary for casting monolithic structures is a cabinet maker's job requiring skilled labor, much lumber and considerable time to build. Mixing and pouring is a difficult and hazardous operation especially when a station is in service. With this type of structure, it is necessary to set bolts by use of template plates and expansion shields, which works a hardship in installing electrical equipment. Moreover, repairs are laborious and expensive.

Many of the same considerations, noted above, apply to the use of bulky, molded materials which are commonly employed in building construction. When used in cell structures, their great weight and bulk, together with the expense of erection and inconvenience of installing electrical equipment, only serves to emphasize the desirability of light-weight fabricated units which eliminate these objections.

The conclusion, for the typical application, seems to be that Trancell materials offer many advantages over other types of product and this is further borne out by experience gained on actual installations during the past decade. For genuine flexibility and for economy of materials and labor of erection, Trancell products are unqualifiedly recommended.

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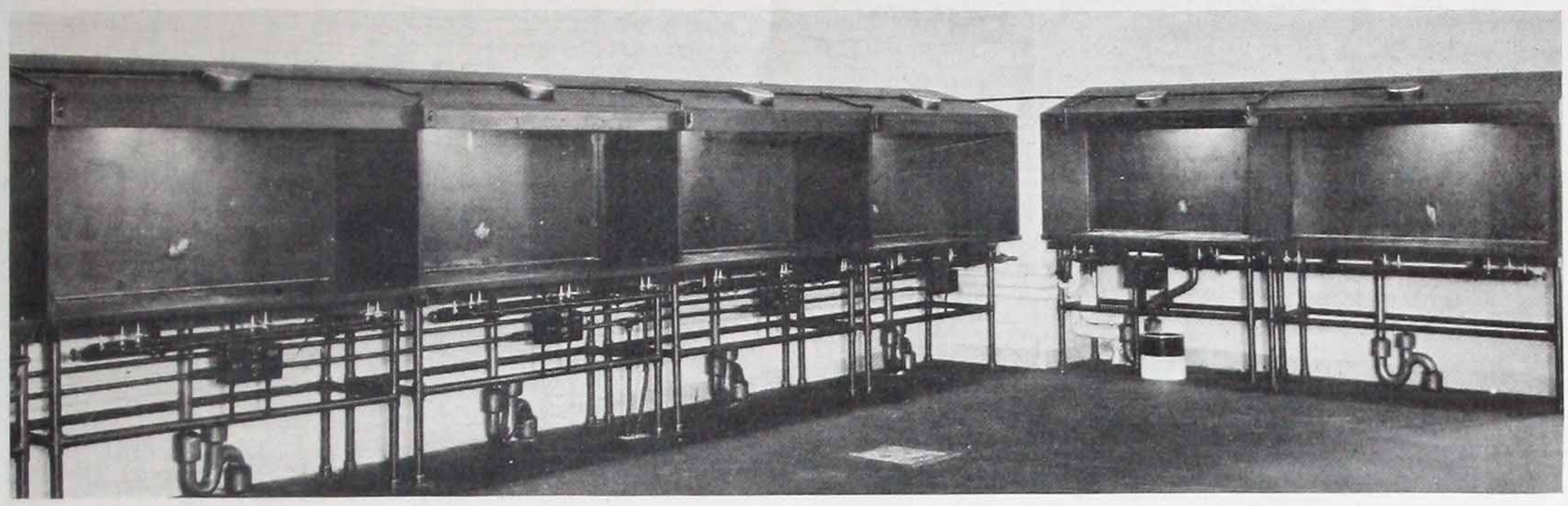
J-M Chemstone



Corner of a chemical laboratory at a leading Eastern university, showing Chemstone fume hoods

J-M Chemstone—for table tops, fume hoods, venti-ting ducts and similar laboratory and chemical plant quipment—was developed to meet the need for a ght-weight, economical material with suitable char-teristics. The desirable characteristics of an ideal aterial for chemical service, as revealed by experi-nce and investigation, are:

Chemical Inertness: If staining, corrosion and structural ilure are to be avoided, the material should be highly resis-nt to chemical attack.

Immunity to Liquids and Solvents: Equipment such as nks, fume hoods, table tops, peg boards, etc., should success-lly withstand the action of solvents and not absorb moisture.

Incombustibility: To reduce fire hazard and withstand ac-dental marring, the material should be not only heat resisting t also fireproof.

Transverse Strength: This attribute in a structural material rmits the use of large-size units in relatively thin sections ith a minimum number of joints and without the need for cessive bracing or framing.

Resistance to Heat and Thermal Shock: This minimizes e possibility of cracking, chipping or spalling. It is espe-ally important in table tops where sudden, localized heat ay be applied.

Resistance to Scratching and Abrasion: Working surfaces ould be able to withstand considerable abrasive action with-t becoming unduly marred.

Resiliency: Such a characteristic provides a "cushioning" ffect which tends to reduce porcelain and glassware breakage.

Appearance: A neat, attractive appearance, maintained with minimum of cost and care, is a desirable feature especially laboratory equipment.

Uniformity of Composition: This characteristic minimizes resses and strains and eliminates weak spots and cleavage lanes. Uniformity of composition is also desirable from a andpoint of the resulting evenness of wear.

Easy Workability: A material which can be worked easily akes for reduced erection costs as well as flexibility of rrangement.

Economy: The service life of a material in relation to its nstalled cost is the most logical measurement of its economy.

The acceptance and continued use of Chemstone in umerous installations indicates the degree to which t possesses the above characteristics.

Description of Chemstone

Chemstone is a tough monolithic material made from asbestos fibre, cement and inert mineral fillers, moulded in one operation into homogeneous sheets. The sheets are completely impregnated with a water-proof, acid-resisting compound and cured. The mono-lithic formation and complete impregnation of the sheets obviate the possibility of veins or areas with less chemical-resisting properties. The method of im-pregnation and subsequent drying imparts to the ex-terior surfaces unusual resistance to corrosive action.

Physical Characteristics:

This material possesses the unusual strength which is characteristic of asbestos-cement products. Even the thinnest sheets offer remarkable resistance to breaking, cracking, spalling and chipping. Yet Chem-stone is relatively light in weight and is workable with regular shop tools. Neither special equipment nor technique is needed for its installation.

The transverse strength of Chemstone permits the use of large sheets which, of course, effect important erection economies and reduce to a minimum the necessary number of joints. The strength of the ma-terial, moreover, permits the use of thinner sheets where otherwise much heavier units would be re-quired, and also eliminates the need for excessive framing or bracing.

Because of its fibrous nature Chemstone is highly resistant to damage by temperature or mechanical shock. Its characteristic fibrous resilience, its "cush-ioning effect" to dropped glassware, eliminates much objectionable clatter and reduces porcelain and glass-ware breakage—both important objectives, especially in large laboratories.

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A large laboratory furniture manufacturer supplied these Chemstone table tops, with a glossy chemical-resisting finish, as part of the completely fabricated units for this chemical laboratory

As a working surface Chemstone has met with universal approval among laboratory workers. Its relatively low thermal conductivity makes it comfortable to the touch. Its dull finish reduces the eye strain which accompanies glare. Where appearance is important, as in exhibition laboratories, Chemstone can be furnished with a polished chemical-resisting finish.

Proper upkeep of Chemstone merely necessitates that it be kept clean. Washing with an alkaline scouring soap and water is all that is needed; an application of hard wax to the surface after cleaning protects the finish and improves the appearance.

A summary of the important physical characteristics of Chemstone includes:

Weight (lb. per sq. ft.):	
1" thickness	11.7
Modulus of rupture (lb. per sq. in.):	
sheets up to ½", inclusive	4500
sheets of greater thickness	3500
Brinnell hardness (500 Kg. on 10 m.m. ball):	
not less than	20
Water absorption (maximum, percent):	
after 48 hours immersion at room temperature	1
after 3 months immersion at room temperature	2
Temperature limits (deg. F.):	
fusing temperature	2300
temperature at which impregnant softens	300

Chemical Resistance:

In general Chemstone has been found very resis n to a considerable majority of the chemicals enc n tered in the laboratory and industrial plant. Its e however, like that of any other material used ur e corrosive conditions, depends upon the numerous v i ables encountered in service. Consequently, a v y accurate statement of the resistance of any such m e rial is almost impossible.* The results of numer s tests of a general character made upon Chemst e serve as a guide to the determination of its adaptal l ity to a specific service condition. These are inclu d in the table shown on the reverse of the follow g Data Sheet, BMM-501.

Since concentration of a corrosive solution, te perature, pressure and other variables must be tak into account, an indication that Chemstone is affect does not necessarily eliminate it from considerati for a specific purpose. For certain uses Chemsto may prove to be the most economical material, ev though attacked, if it will last longer than any oth material available at the same installed cost. Th most satisfactory test is made by the use of a samp of the material under actual conditions of the co templated service.

Finishes:

The standard finish of Chemstone is brownish blac in color and has the texture of a medium-sanded su face. The sheets afford a very satisfactory surfac where service and durability are the prime considera tions. If a smooth finish is required, however, th sheets may be ordered sanded and polished on one o both sides at a nominal extra charge. For severe ser vice conditions, if the sanded and polished surface i specified, it is recommended that it be additionall protected by a chemical-resisting enamel finish. Recommendations as to suitable enamels for a specific service condition may be secured from Johns-Manville.

For exhibition or display laboratories, it may be preferable in many instances to purchase completely built and finished units from one of the several laboratory furniture manufacturers.

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* "Laboratory tests made with chemically pure reagents under carefully controlled conditions seldom, if ever, approach actual operating conditions of service. At best the laboratory data reported . . . are to be used only as an indication as to whether or not service tests or trial installations are advisable. In no case should they be used to calculate a depreciation rate or to estimate the life of equipment. . . . in regard to specific problems *Chem. and Met.* urgently recommends the submission of the very fullest information in regard to the actual conditions encountered in the plant. Failure to report a minor constituent such as the presence of an impurity or an unusual condition as regards agitation, velocity, concentration or temperature, may result in the selection of an improper material. . . . " From "Materials of Construction for Chemical Engineering Equipment" in *Chemical and Metallurgical Engineering;* (supplement) September, 1929.

Dimensions of Standard Sheets:

Chemstone is furnished in the following sizes and thicknesses: 36″ x 48″, from 1/8″ to 2″ thick; 42″ x 48″ and 42″ x 96″, from 1/4″ to 2″ thick.

Uncut sheets run somewhat full in length and width. Material cut to special size is furnished plus or minus 1/32″ of specified length and width.

Standard thicknesses are 1/8″, 3/16″, 1/4″, 5/16″, 3/8″, 1/2″, 5/8″, 3/4″, 7/8″, 1″, 1 1/4″, 1 1/2″, 1 3/4″ and 2″. At a nominal charge the sheets may be furnished in intermediate thicknesses by sanding down sheets of the next greater thickness. Thicknesses of 3/4″ or less have a tolerance of plus 1/16″; thicknesses of 7/8″ and over have a tolerance of plus 1/8″. The thickness tolerance of sanded and polished sheets and sheets sanded to intermediate thicknesses is plus or minus 1/32″.

Uses of Chemstone

Fume Hoods:

The large-size sheets, easy workability, strength and light weight of Chemstone as well as its chemical resistance make it an unusually desirable fume hood material. Its physical properties effect erection economies; its chemical resistance makes for durability. With Chemstone the structural support requirements are less, and the difficulties of joint construction are reduced to a considerable degree.

Ventilating Ducts:

Long life is an important consideration in duct systems because to the cost of replacement materials must often be added the cost of reaching ducts concealed behind walls or ceilings. The long life of Chemstone compared with many surface-treated materials renders it more suitable as a duct material in chemical laboratories and plants. Moreover, its relatively light weight as well as the large size of the sheets makes Chemstone an economical duct material.

Chemstone was used for these table tops; the fume hoods in the background are made of Transite

Table Tops:

The resistance of Chemstone to the majority of chemicals, together with the acceptability of its surface by laboratory technicians, recommends its use for table tops. The fibrous resilience of the material reduces porcelain and glassware breakage, as well as the clatter incidental to laboratory work. Available in large-size sheets, Chemstone permits construction with a minimum number of joints.

Other Equipment:

Tanks, tank covers, smoke washers, sinks, shelves, peg boards and similar equipment are readily fabricated from Chemstone. Its easy workability makes for economical construction of such units.

If the purity of chemicals is important, the contemplated tank or tank cover materials should be tested before ordering. Certain organic chemicals tend to dissolve the impregnant from the surface of Chemstone and consequently become discolored.

J-M Transite Asbestos Sheets

J-M Transite, an unimpregnated cement-asbestos material, is suitable for many chemical uses such as process tanks and tank covers for some solutions where impregnated materials are undesirable. It may also be effectively used under some conditions for fume hoods and ventilating ducts. For service where Chemstone is unsuitable and corrosion is severe, the Transite, coated with a chemical-resisting finish to provide the necessary protection, may afford a durable, economical installation.

Unlike many materials, Transite is not subject to scaling or excessive warping. In general, it possesses the same physical properties as Chemstone, but is not as resistant to the absorption of liquids, especially under continuous contact. When heat resistance is an important consideration, Transite may be effectively used. It resists constant temperatures up to 600 or 700 deg. F. indefinitely, and momentary applications of temperatures far in excess of these. Additional information on Transite is available on other data sheets.

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J-M Chemstone Cement

Chemstone Cement is a black, waterproof, chemical-resisting adhesive especially developed for use with Chemstone. This cement makes a strong, durable bond between adjoining sheets of Chemstone and between Chemstone and other structural materials such as wood, glass or metals. The adhesive has a natural affinity for Chemstone, but it also affords a dependable bond between other materials.

Chemstone Cement is a good general utility adhesive and joint material for chemical service. It is resistant to most classifications of chemicals. The coal tar solvents and highly solvent organic chemicals, however, should not be permitted to remain in cont with it for extended periods of time. Under sev organic solvent conditions, the cement tends to soft and eventually the bond will fail.

Chemstone Cement has a consistency of a hea putty. It may be applied at room temperature, a can be easily spread with a putty knife. The materi weighs approximately 12.7 lb. per gal., and when a plied 1/32" thick, has a coverage of approximate 4 sq. ft. per lb. It is packed in 2 and 5-lb. containe When not in use, the cement should be kept tight sealed in its container.

Chemical Resistance of Chemstone and Transite

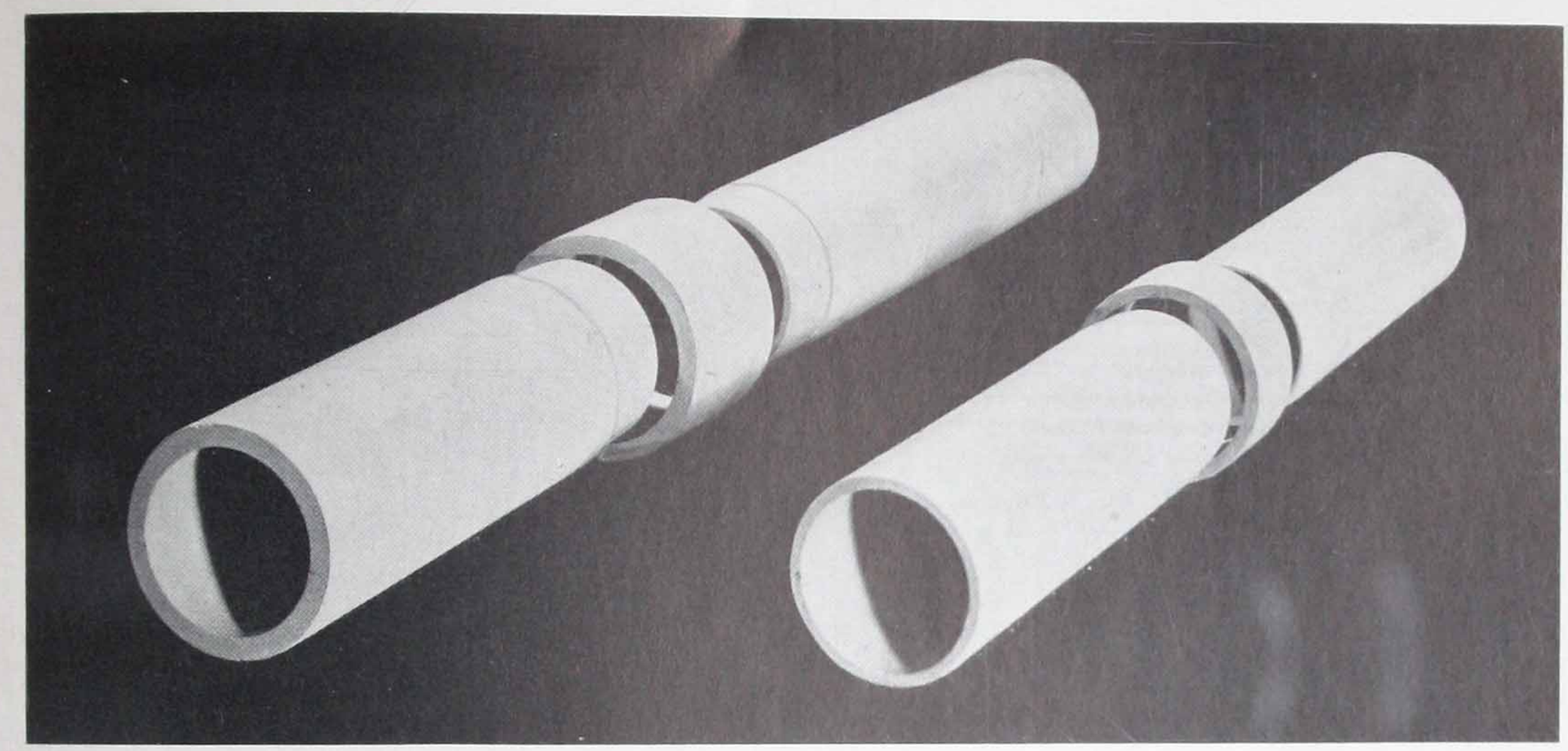
Check (√) denotes satisfactory behavior of material under indicated conditions

Chemical Reagent	Chemstone Concentration: Less than 5%	Chemstone Concentration: Moderate	Chemstone Concentration: Concentrated	Transite Concentration: Less than 5%	Transite Concentration: Moderate	Transite Concentration: Concentrated	Material satisfactory with protective coating*
Acids							
Acetic	√	√	. . .	. . .	. . .	. . .	C
Carbolic (Phenol)	√	√	√	√	√	√	. . . . .
Carbonic	√	√	√	√	√	√	. . . . .
Citric	√	√	√	√	√	√	. . . . .
Formic	√	√	√	. . .	. . .	. . .	. . . . .
Hydrochloric	√	. . .	. . .	. . .	. . .	. . .	C
Hydrofluoric (1%)	. . .	. . .	. . .	. . .	. . .	. . .	. . . . .
Nitric	√	. . .	. . .	. . .	. . .	. . .	C
Nitrous	√	√	√	. . .	. . .	. . .	. . . . .
Oxalic	√	√	√	. . .	. . .	. . .	. . . . .
Phosphoric	√	√	√	. . .	. . .	. . .	T
Sulphuric	√	. . .	. . .	. . .	. . .	. . .	C
Sulphurous	√	√	. . .	. . .	. . .	. . .	C
Tannic	√	√	. . .	. . .	. . .	. . .	C & T
Bases							
Ammonium hydroxide	√	√	√	√	√	√	. . . . .
Sodium hydroxide	√	√	√	√	√	√	. . . . .
Organic Solvents**							
Acetone	√	√	√	√	√	√	. . . . .
Amyl acetate	√	√	√	√	√	√	. . . . .
Benzene (C_6H_6)	. . .	. . .	. . .	√	√	√	. . . . .
Butyl acetate	√	√	√	√	√	√	. . . . .
Carbon bisulphide	. . .	. . .	. . .	√	√	√	. . . . .
Carbon tetrachloride	. . .	. . .	. . .	√	√	√	. . . . .
Ethyl acetate	. . .	. . .	. . .	√	√	√	. . . . .
Ethyl alcohol	√	√	√	√	√	√	. . . . .
Gases							
Ammonia (anhydrous)	√	√	√	√	√	√	. . . . .
Chlorine†	√	√	√	. . .	. . .	. . .	. . . . .
Hydrogen sulphide†	√	√	√	√	√	√	. . . . .
Sulphur dioxide†	√	√	√	. . .	. . .	. . .	T

Chemical Reagent	Chemstone Concentration: Less than 5%	Chemstone Concentration: Moderate	Chemstone Concentration: Concentrated	Transite Concentration: Less than 5%	Transite Concentration: Moderate	Transite Concentration: Concentrated	Material satisfactory with protective coating*
Salts							
Aluminum chloride	√	√	√	. . .	. . .	. . .	T
Aluminum sulphate	√	√	√	. . .	. . .	. . .	T
Ammonium chloride	√	√	√	√	√	√	. . . . .
Ammonium nitrate	√	√	√	. . .	. . .	. . .	T
Ammonium sulphate	√	√	√	. . .	. . .	. . .	T
Amyl chloride	. . .	. . .	. . .	√	√	√	. . . . .
Calcium chloride	√	√	√	√	√	√	. . . . .
Calcium hypochlorite	√	√	√	√	√	√	. . . . .
Copper sulphate	√	√	√	. . .	. . .	. . .	T
Ferric chloride	√	√	√	. . .	. . .	. . .	T
Ferric sulphate	√	√	√	. . .	. . .	. . .	T
Ferrous chloride	√	√	√	. . .	. . .	. . .	T
Ferrous sulphate	√	√	√	. . .	. . .	. . .	T
Magnesium chloride	√	√	√	. . .	. . .	. . .	T
Magnesium sulphate	√	√	√	. . .	. . .	. . .	T
Sodium carbonate	√	√	√	√	√	√	. . . . .
Sodium ferricyanide	√	√	√	√	√	√	. . . . .
Sodium hypochlorite	√	√	√	√	√	√	. . . . .
Sodium nitrate	√	√	√	√	√	√	. . . . .
Sodium phosphate	√	√	√	√	√	√	. . . . .
Sodium sulphide	√	√	√	√	√	√	. . . . .
Sodium sulphite	√	√	√	√	√	√	. . . . .
Miscellaneous							
Aniline	√	√	√	√	√	√	. . . . .
Benzaldehyde	√	√	√	√	√	√	. . . . .
Chlorine (saturated solution)	√	√	√	. . .	. . .	. . .	T
Formaldehyde	√	√	√	√	√	√	. . . . .
Hydrogen peroxide (3%)	√	√	√	√	√	√	. . . . .
Salt water	√	√	√	√	√	√	. . . . .
Atmosphere†							
Oxidizing	√	√	√	√	√	√	. . . . .
Reducing	√	√	√	√	√	√	. . . . .

*C=Chemstone; T=Transite. Full details regarding protective coatings may be secured from Johns-Manville upon request.
**In general, Transite offers better chemical resistance than Chemstone to organic solvents.
†For temperatures to 150 deg. F.

Transite Conduit and Korduct



Transite Conduit and Korduct with Harrington couplings

The ultimate value of a conduit system for electrical conductors does not depend upon its initial cost alone, but rather upon its ability to serve and properly protect the cables and other electrical equipment for a long period of years.

To insure most satisfactory and economical service, the conduit must be permanent. This, of course, implies that the material must be incombustible, mechanically strong, resistant to corrosive action and unaffected by electrolysis. An ideal conduit material should have a rapid rate of heat dissipation, and a low frictional coefficient. It should also be light in weight and easily installed.

J-M Transite Conduit, because of its asbestos-cement composition and the method of manufacture, has fulfilled these requirements to the satisfaction of users from the time when it was first offered to industry. It is sufficiently strong and durable to be used in underground systems without the conventional concrete envelope.

J-M Transite Korduct, a newly developed, lightweight material, is identical with Transite Conduit except in wall thickness. It is designed for use where the duct is to be incorporated in concrete or masonry structures and where underground conditions necessitate a concrete envelope. Because of its light weight, Korduct offers important installation economies.

Since 1900 Johns-Manville has combined asbestos fibre and cement under pressure to form a waterproof, corrosion-resistant, fireproof material known as Transite. Many millions of square feet of Transite have been used for roofing and siding of buildings; for vents, flues and stacks; for boiler and furnace casings; and for a wide variety of other uses which demand a construction material of enduring nature. In the electrical industry it has been used with satisfaction for switch cells, barriers and ducts.

In 1929, Johns-Manville began the development and manufacture of Transite in pipe form* by building up the asbestos-cement mixture, under pressure, on smooth metal mandrels. Since that date many million feet of Transite pipe have been sold in the United States and Canada for installation as underground water mains, process liquor lines, flue and vent pipes. A pipe of this nature has been manufactured in Italy since 1913 and subsequently has found wide adaptation in other countries. In all these countries the desirable qualities of the material have caused its adaption for electrical service. In the United States over one and one-half million feet of Transite Conduit have been installed.

*Manufactured under process patents owned by the Societa Anonima "Eternit" Pietra Artificiale.

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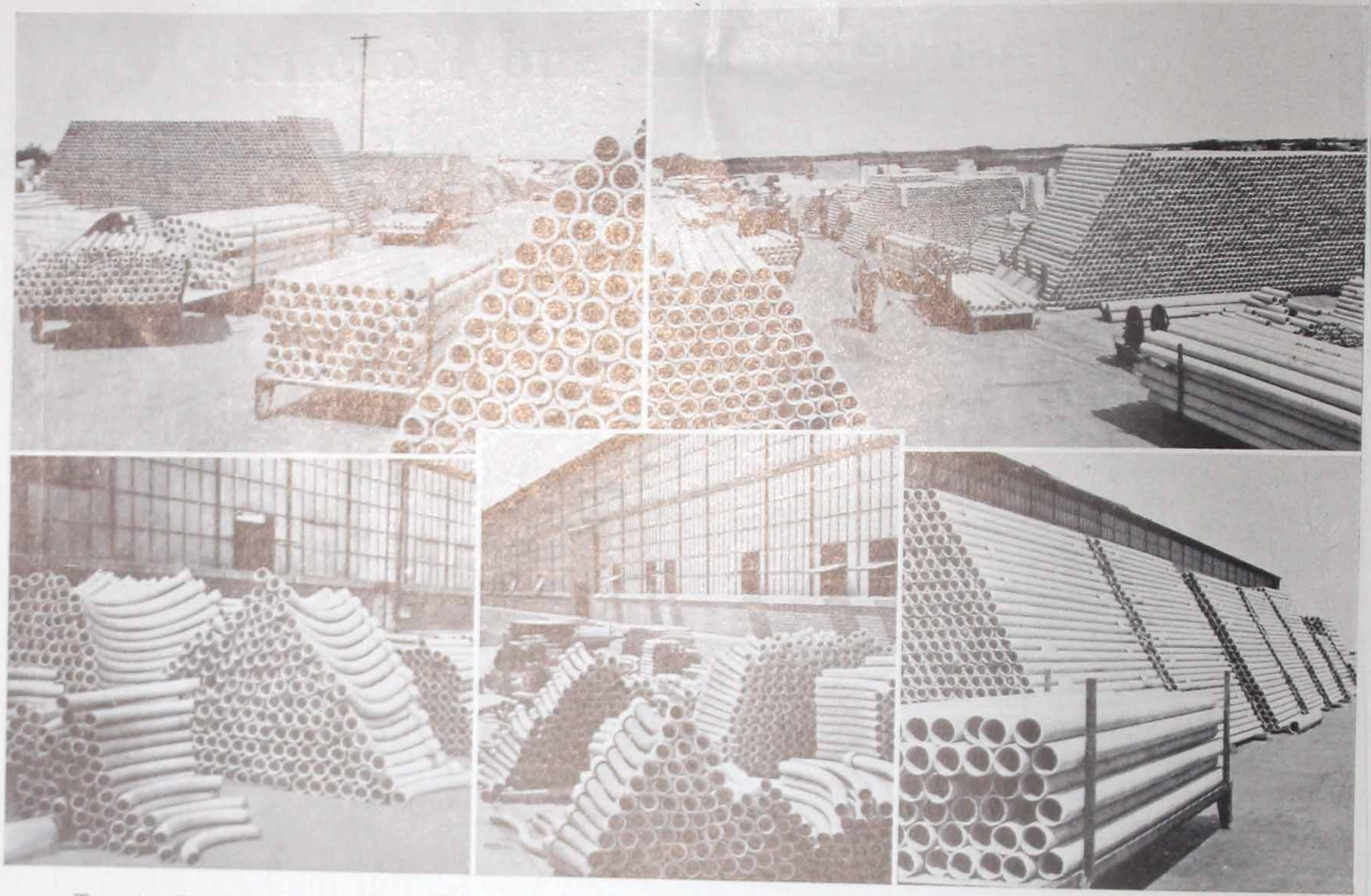

Transite Conduit and Korduct are manufactured at the Johns-Manville plants in Waukegan, Illinois and Manville, N. J., where ample stocks of all sizes are maintained for immediate delivery

Advantages of Transite Conduit and Korduct

Because of the nature of the material and the method of manufacture, Transite affords a conduit with long life in service and all the other qualities required of an ideal duct material.

Strength: When asbestos fibre is combined with cement, under pressure, a surprisingly strong material is produced. Compared with ordinary first quality concrete, it has approximately five times the tensile strength and three times the compressive strength.

Transite Conduit has considerably greater crushing strength than is ordinarily required for culvert work. This means it has sufficient strength, without a concrete envelope, to resist any load that will be normally put upon it when installed under streets and highways. Its strength as a beam is such that, when properly installed in firm ground, it will resist all normal stresses.

Transite Conduit fulfills all the requirements of an exposed conduit except where severe mechanical stress, particularly shock, must be resisted.

Transite Korduct is just as strong per unit of wall thickness as Transite Conduit but because of its thinner wall, it is recommended for use only where a concrete envelope is necessary or under conditions where mechanical strength is not a prime requirement.

Corrosion Resistance: Transite is practically unaffected by external and internal corrosion. It will resist the corrosive action of cinder fills, salt marsh soils and other naturally severe conditions. Only the most troublesome soils have any effect upon it.

In addition, Transite is highly resistant to the corrosive action of many chemicals. Weather conditions have little, if any, effect on Transite. In fact, conduits made from this material can be stored outdoors, both summer and winter, for long periods of time without injury.

Incombustibility: Because of the ingredients which enter into its make-up, Transite is positively incombustible. It will not contribute to the generation of fumes or combustible gases when burnouts occur, and its resistance to heat, flame and arc is very high.

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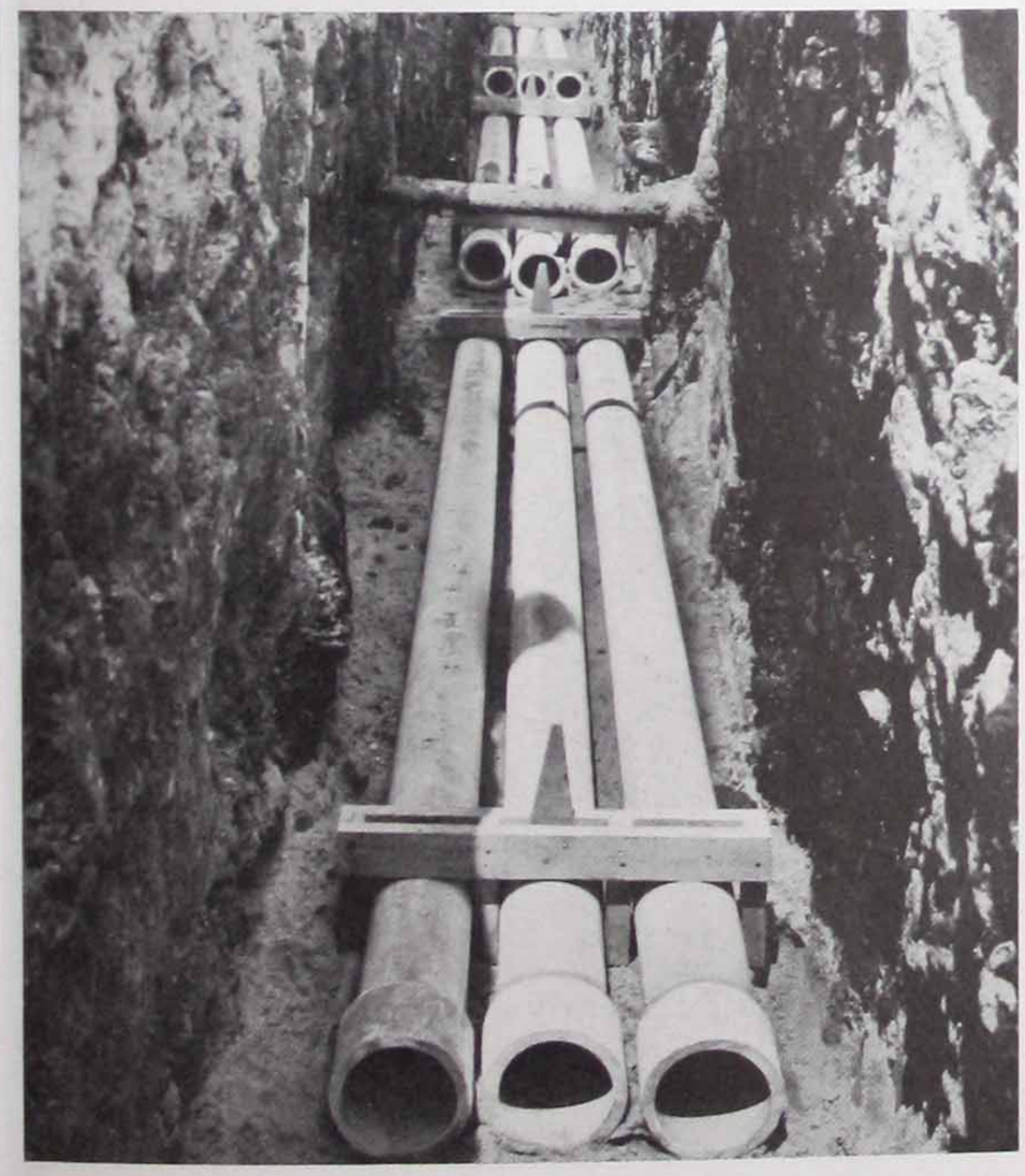
Low Coefficient of Friction: The close-grained structure of Transite provides a smooth interior surface. The resultant low coefficient of friction permits long pulls of cable through the duct with ease. No dangerous abrasive particles are present on the interior surface that might damage the cable sheath.

High Thermal Conductivity: The thermal conductivity of Transite for the service encountered in duct lines is about 4 B.t.u. per sq. ft. per deg. F. temperature difference, per inch thick, per hour. This relatively high thermal conductivity in the field of non-metallic conduits permits the heat generated within the cables to be readily dissipated.

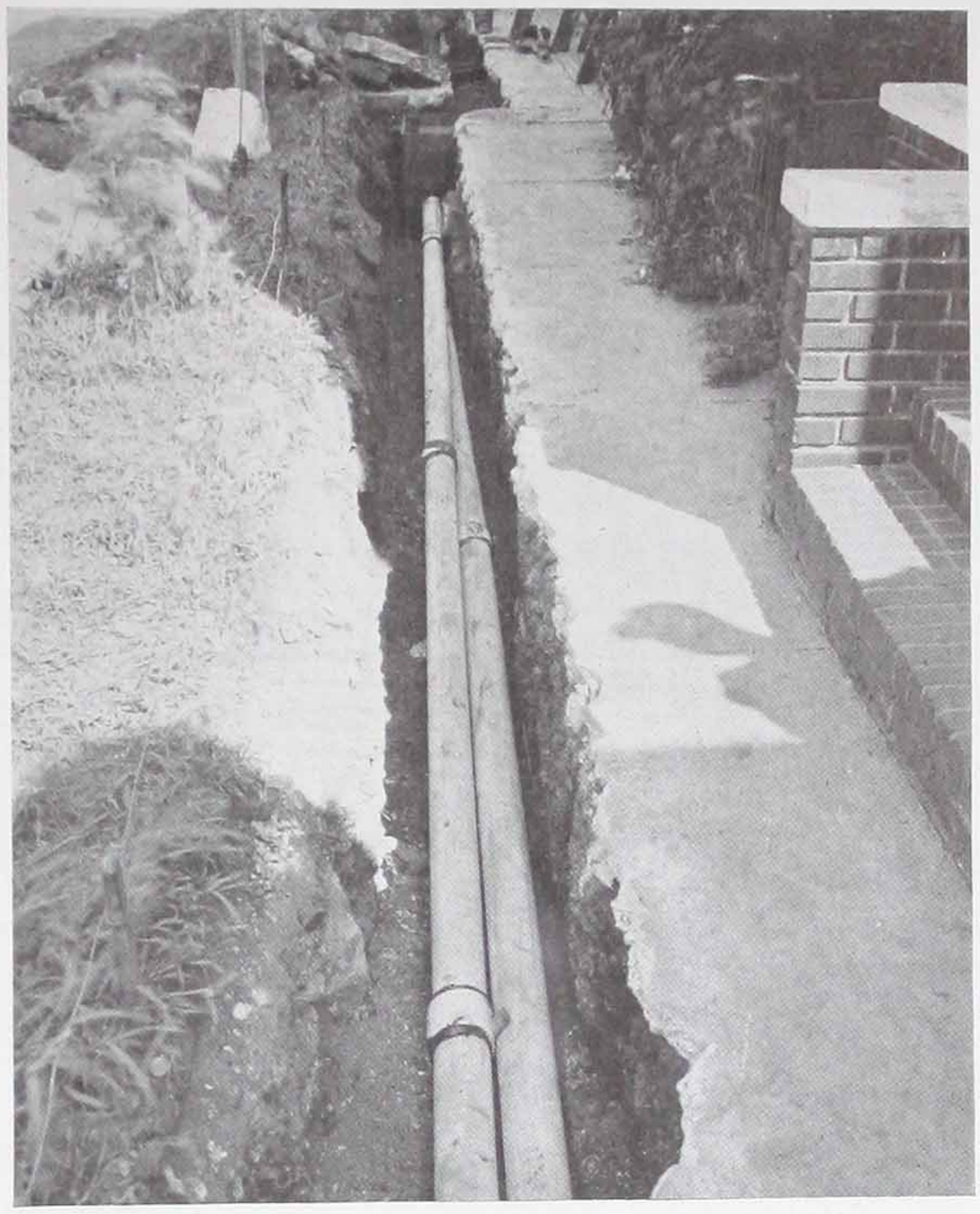
Immunity to Electrolysis: The use of non-conductive materials in the manufacture of Transite makes it immune to electrolysis.

Non-induction: Because of its nature, Transite is also non-inductive. This is an especially important property in conduit carrying single-phase alternating current lines.

Inertness: Extensive research has developed a new process which insures a rapid completion of the chemical reaction that the cement in Transite undergoes when curing. As a result of this process, a chemically inert material is produced.



A 9-way Transite Conduit duct line for power and signal cables, installed without a concrete envelope by the Chicago Surface Lines, Chicago, Ill.



Transite Conduit for distribution feeders and services in sidewalk area. Note facility of changing from vertical arrangement in manhole to horizontal in trench

This special process of curing permits a substantial reduction in alkalinity as determined by the free lime present in the composition. The alkalinity of Transite is reduced to less than 25 percent of that normally obtaining on ordinary portland cement products. As a result, water in contact with Transite is no more corrosive than is ordinary soil water which, as has been shown by many years of experience, is not at all detrimental to a good cable sheathing.

Installation Advantages: Mechanical strength and comparatively light weight make possible the manufacture of Transite Conduit and Korduct in long, easily-handled lengths. This advantage makes for rapid installation and a minimum number of joints.

Tight joints are assured in Transite Conduit by the use of Harrington couplings which are machined to fit snugly over the tapered ends of the conduit sections and fittings. The same type of coupling can be supplied with Transite Korduct when very tight joints are desirable. In addition, multiple units can be easily assembled on the job or in the shop.

Transite is readily workable. Both types of duct can be easily cut, tapered and otherwise machined.

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Applications of Transite Conduit

Transite Conduit lends itself to a wide range of service in the electrical field. It is equally suited to installation underground and overhead. For overhead work, it can be used both within the building and outdoors. It does not require a concrete protective envelope for underground service.

Underground Conduit:

Transite Conduit has been used with entire satisfaction since 1930 in underground conduit installations without the protection of concrete. Its strength and permanence together with its other desirable properties recommend it as the ideal conduit for this type of installation. Over a million feet, so installed, are now in service.

An underground conduit installation without concrete envelope in the vicinity of Pittsburgh, Pa.

Among the types of circuits in service in such installations are:

Power Circuits

services
secondary distribution mains
primary feeders
series and multiple street lighting circuits
transmission cables

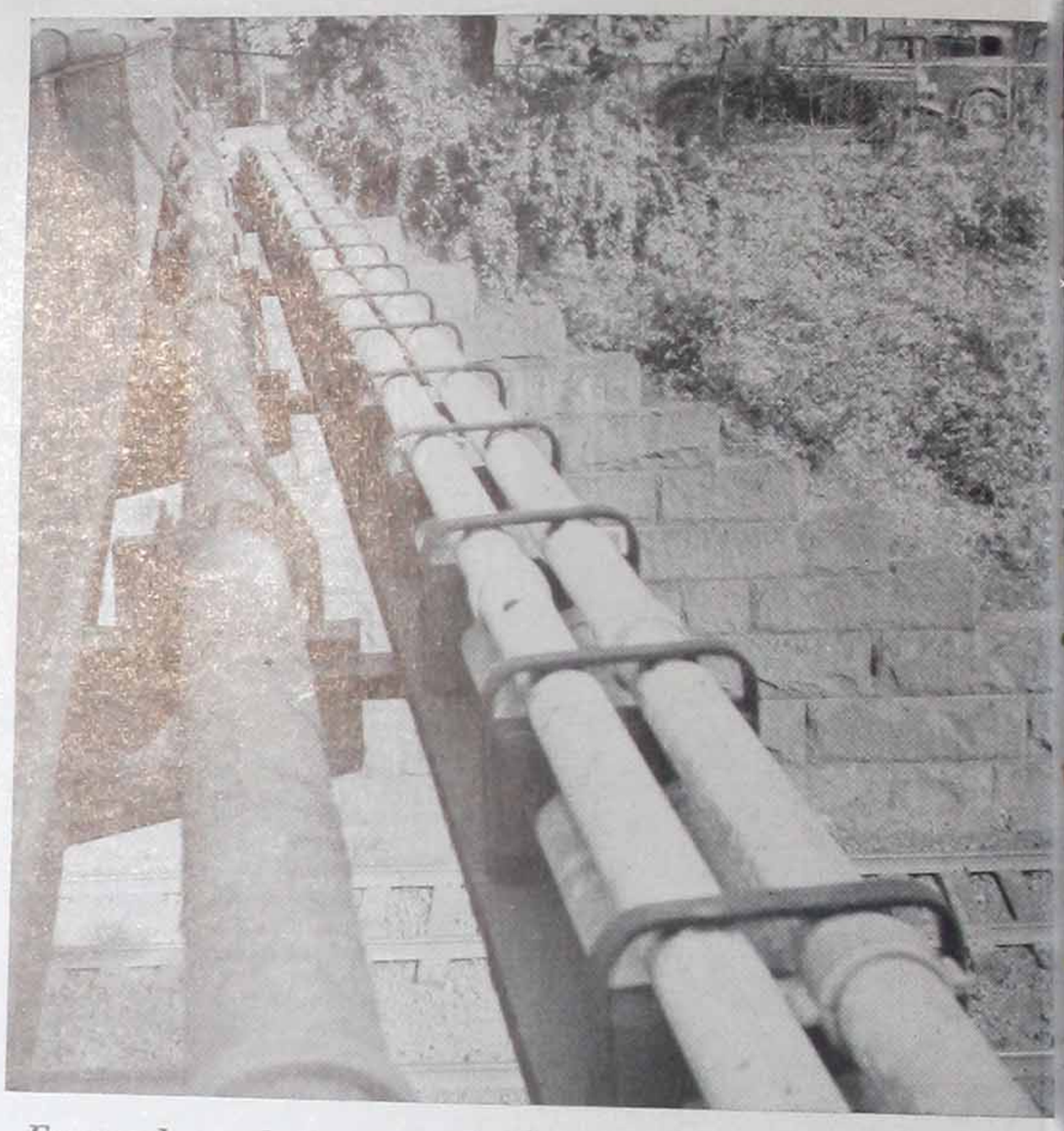
Communication Circuits

telephone services
exchange feeder cables
telegraph cables

Signal Circuits

fire alarm
police signal
railway signal

The elimination of the concrete envelope affords important economies especially in the case of smaller duct lines. Estimates of savings generally vary from 10 to 30 percent on lines up to 6 ducts per trench.



Exposed conduits on a bridge over railroad tracks near Boston, Mass.

The experience of users indicates that, in every case actual savings are equivalent to, if not greater than the estimates. Actual savings of as much as 50 percent of the total cost of the installed line have been reported. The great range of variation is readily understood when consideration is given to the exceedingly variable nature of such items as the type of paving involved, type of soil, cost of excavation and number of ducts per trench.

Transmission and distribution bank installed without concrete envelope in Staten Island, N. Y.

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Insulation

J-M Industrial Insulating Materials reduce operating costs and improve performance wherever heated or refrigerated equipment is used

INSULATION is used to retard heat flow where it is desired to maintain a temperature either higher or lower than that of the surroundings. Whether heating or refrigerating is involved, insulation is essential to economical operation.

Heated Equipment:

In industrial furnaces, while fuel saving is the principal advantage of insulation and the one most readily convertible into dollars and cents, there are other attendant advantages which in many classes of work are considered to be at least as important as the saving of fuel. First among these is the improvement in the quality of heat-treated products which is brought about by the more uniform heat distribution and more accurate temperature control which is possible with insulated equipment.

Other advantages of industrial furnace insulation are increased capacity of the equipment; protection to brickwork from rapid temperature changes; reduction of internal strains and cracking; and an improvement in working conditions about the equipment.

In the case of boilers, insulation over bare metal surfaces is even more essential than over brickwork. Steam pipe insulation reduces condensation, permitting the delivery of drier steam, and through heat saving pays for itself several times each year.

Refrigerated Equipment:

From the standpoint of economical operation, insulation of low temperature equipment and structures is especially important. A ton of refrigeration, which is equivalent to the removal of 288,000 B.t.u. per 24 hours, costs approximately ten times as much as the equivalent number of B.t.u. when produced for heating purposes. The necessity for much heavier insulation on low temperature work than is customary for high temperatures is therefore immediately apparent. Furthermore, many forms of cold storage demand that temperatures be controlled within a narrow range, a condition equally common in the cold processing of oils and chemicals. Such close temperature control cannot be maintained without adequate insulation.

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Thickness of Insulation

The economical thickness of insulation depends primarily upon the temperature and the cost of heat. The thickness is ordinarily computed on the basis of fuel costs and operating conditions so the heat which passes through the insulation is only that portion which may not economically be saved. Sometimes special conditions require thicker insulation than would be warranted by fuel saving.

The economical thickness of pipe insulation also depends on the pipe size. While it is a fact that small pipes would have to be more heavily insulated to give the same saving of heat, it is nevertheless true that the larger pipes should be provided with thicker insulation in order that the maximum net saving be realized. A 1″ pipe with 1″ thick insulation will lose heat more rapidly per square foot of pipe area than a 10″ pipe with the same thickness of insulation; because the outside surface of the insulation on the 1″ pipe is nearly 200% greater than that of the pipe, while the outside area of the insulation on a 10″ pipe is less than 20% greater. As a result of the greater area of material through which heat may flow, the losses from the 1″ pipe must be greater.

The matter of net saving takes into account both the saving per year and the cost per year of effecting that saving. Therefore, since the insulation on a 1″ pipe costs from 1½ to 3 times as much per square foot of pipe surface as on a 10″, and since each inch of thickness on a 10″ pipe saves more heat than the same on a 1″, it is at once evident that it pays to put a thicker insulation on a 10″ than on a 1″ pipe.

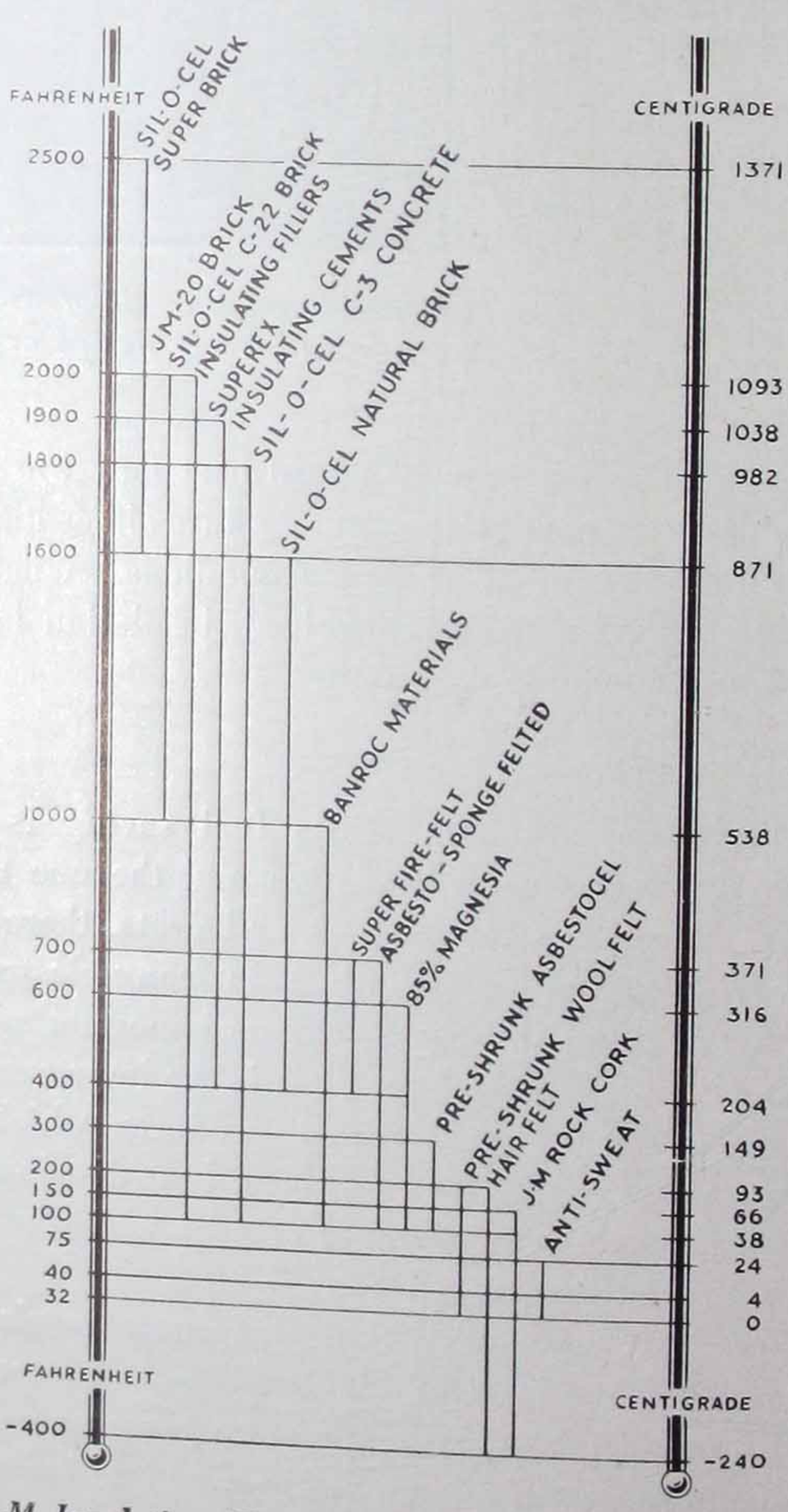
Selection of Insulation

To be adaptable, insulation must be of such form as to be easily applied. It must have heat-resisting qualities sufficient to withstand successfully the highest temperatures to which it will be subjected. It must be sufficiently strong and durable to assure long life. Adaptability also depends upon many other conditions incidental to the particular application.

The efficiency of a commercial insulation depends primarily upon the small voids which it contains. In order to be most effective, the voids must be enclosed and so small that circulation within them and radiation across them will be at a minimum. Small void size is particularly important at high temperatures because of the rapid increase in convection and radiation with rise in temperature.

From the four mineral products—asbestos, magnesium carbonate, diatomaceous silica (Celite), and rock wool—Johns-Manville furnishes insulation in forms of sectional pipe covering; insulating sheets, blocks, bricks and blankets; insulating cements, fillers and finishes; insulating papers and felts; as well as light-weight aggregate used with portland cement in making insulating concrete. A wide range of refrigeration products such as hair felt and Rock Cork complete the line.

There is a J-M product for every heat-insulating purpose. Materials are available for use throughout the entire range of temperatures used in industrial processes, from the extreme sub-zero temperatures used in the treatment of oils, chemicals, etc., to 300 deg. F. and more, used in many modern industrial plants. The temperatures below are those applied to the insulation, rather than process temperatures.



J-M Insulating Materials cover the entire range of industrial temperatures

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J-M Brick, Sheet and Block Insulation

Insulation in the shape of bricks, sheets and blocks is generally most suitable for flat or moderately curved surfaces. Brief descriptions of some of the J-M materials available are given in the following paragraphs:

Insulating Brick

JM-20 Insulating Brick (Temperature limit, 2000 deg. F.). Made from high quality refractory clay and a specially manufactured mineral fibre. Used as a back-up insulation and as an insulating refractory where there is no flame impingment, slag action or mechanical abrasion. Crushing strength approximately 90 lb. per sq. in. Furnished in standard fire brick size, 9″ x 4½″ x 2½″ (packed 25 per carton) and in other fire brick shapes. The 2½″ weigh approximately 1.65 lb. each.

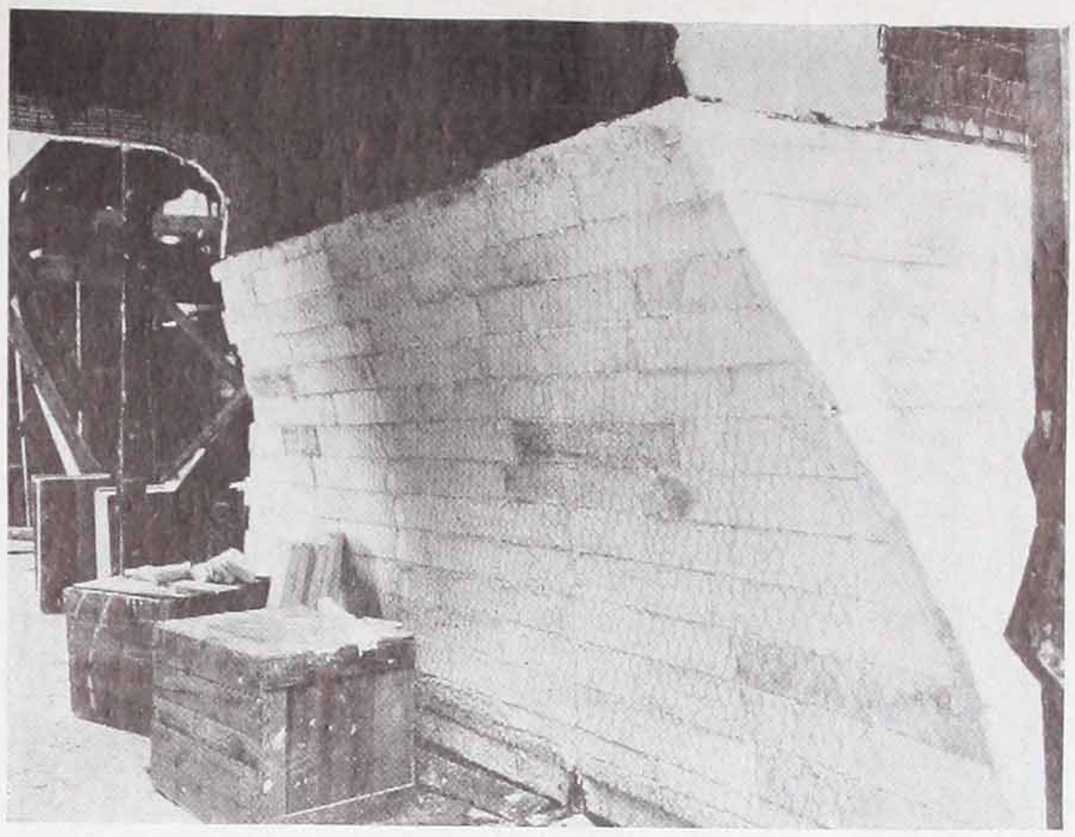
Sil-O-Cel C-22 Brick (Temperature limit, 2000 deg. F.). Moulded and calcined diatomaceous silica (Celite). This brick is used as insulation behind refractory and also as an inner lining to replace fire brick in high temperature furnaces where it is not subject to mechanical abrasion or slag action. Crushing strength approximately 700 lb. per sq. in. Furnished in standard fire brick size, 9″ x 4½″ x 2½″, and in other fire brick shapes. The 2½″ brick is packed 25 per carton. Mortar is furnished extra at an additional charge. Weight of 2½″ brick is 2¼ lb. each.

Sil-O-Cel Natural Brick (Temperature limit, 1600 deg. F.). Natural diatomaceous silica (Celite). The most efficient insulating brick obtainable. Crushing strength approximately 400 lb. per sq. in. Furnished same as C-22 Brick. Weight: 2½″ brick, 1¾ lb.

Sil-O-Cel Super Brick (Temperature limit, 2500 deg. F.). Moulded and calcined diatomaceous silica (Celite). This brick is used as back-up insulation and also is applied without fire brick protection for lining electrically heated and muffle type furnaces. Crushing strength approximately 350 lb. per sq. in. Furnished same as C-22 Brick. Weight: 2½″ brick, 2¼ lb.

Sheets and Blocks

Asbesto-Sponge Felted (Temperature limit, 700 deg. F.). Built up of laminated asbestos felts, in which are embedded small particles of spongy, cellular material. Withstands rough usage; can be removed and replaced without injury. Furnished 36″ long by 6″, 9″, 12″, 18″, 24″ and 36″ wide, from ½″ to 4″ thick. Weight approximately 2½ lb. per board foot. It is often used as a second layer outside Superex.



Breeching being insulated with 85% Magnesia. Block sizes are convenient in applying insulation over metal surfaces

Asbestos Fire-Felt (Temperature limit, 1000 deg. F.). Manufactured and furnished like Super Fire-Felt but with greater mechanical strength. Weight per board foot approximately 3.3 lb.

Super Fire-Felt (Temperature limit, 700 or 900 deg. F.). Made of asbestos fibre which has been formed to shape with binding material. Can be easily moulded to fit irregular surfaces. Used where a light, strong insulating material is required. Supplied sheets 24″ x 36″ and blocks 6″ x 36″ from ½″ to 4″ in thickness. Curved and special shapes available on special order. When used between metal sheets or brick lining and steel shell, it may be used for temperatures up to 900 deg. F. Weight per board foot approximately 1.7 lb.

Improved Asbestocel (Temperature limit, 300 deg. F.). Made of alternate plain and corrugated asbestos felts with cross-corrugations at regular intervals, built up to the required thickness. Used on medium or low pressure boilers, warm air ducts, etc. Furnished with 4 plies per inch of thickness in sizes 6″, 9″, 12″, 18″ and 36″ wide by 36″ and 72″ long from ½″ to 4″ thick. Weight approximately 1 lb. per board foot. **Fine Corrugated Improved Asbestocel** has 6 plies per inch of thickness. Furnished in the same sizes as 4 ply material. Weight approximately 1.3 lb. per board foot.

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85% Magnesia Blocks and Lagging (Temperature limit, 600 deg. F.). One of the most efficient commercial insulations. Made of hydrated basic carbonate of magnesia bonded with asbestos fibre. Blocks are furnished 3″, 6″ and 12″ wide by 18″ or 36″ long. Other sizes and lagging supplied on special order. Thickness of flat blocks, 1″ to 4″ in increments of ⅛″; curved blocks, from 1¼″ to that which can be cut from a 4″-thick block. Radius of curvature which blocks should fit must be specified on the order. Weight per board foot approximately 1.4 lb.

Pan-O-Cel Sheets (Temperature limit: Type A, 500 deg. F.; Type B, 250 deg. F.). Self-supporting panel insulation made of finely corrugated asbestos felts, sealed within sheets of plain asbestos felt coated with a refactory solution. Used in the construction of drying rooms, low temperature ovens and similar equipment. Type B is used instead of Type A when a more moisture-resistant material is required. Both types furnished 36″ x 36″, 36″ x 72″, 36″ x 84″ and in special sheets up to 68″ x 100″. Thickness from 1″ to 4″. Weight of 2″ thickness approximately 4 lb. per sq. ft.

Rock Cork Sheets, Lagging and Discs (Temperature limit, 100 deg. F. or 150 deg. F. in ducts). A highly efficient material for cold storage and refrigerating equipment. Made from rock wool combined with a waterproof binder. Standard size sheets are 18″ x 36″ in 1½″, 2″, 3″ and 4″ thicknesses; also 18″ x 18″ x 1″. Weight approximately 1.25 lb. per board foot. Discs are furnished from 1½″ to 4″ thick up to 18″ wide. Two piece discs available up to 36″.

Superex Blocks (Temperature limit, 1900 deg. F.). A combination of diatomaceous silica and asbestos fibre, bonded together. A highly efficient material for insulating boiler walls, furnaces, etc. Blocks are 3″, 6″ and 12″ wide by 18″ or 36″ long. Other sizes on special order. Thicknesses of flat blocks, 1″ to 4″ in increments of ⅛″; curved blocks, from 1¼″ to that which can be cut from a 4″-thick block. Radius of curvature which blocks should fit must be specified on the order. Weight per board foot approximately 2 lb.

Blankets, Paper, Millboard

Asbestocel (Temperature limit, 300 deg. F.). Made of a plain and corrugated asbestos felt, cemented together, with an approximate thickness of ¼″. Also furnished in fine corrugated, 1/6″ thick. Used for hot-air heater or furnace pipes. At least two layers should be used. Furnished 36″ to 37″ wide in rolls of approximately 250 sq. ft.

Asbestos Blankets (Temperature limit, 900 deg. F.). Flexible insulation made of asbestos cloth, filled with asbestos fibre and quilted. Used for covering irregular surfaces, such as the shells of paper digesters and casings of steam turbines, where removable insulation is desired. Furnished to order in 1½″, 2″ and 2½″ thicknesses in single layer and 3″, 4″ and 4½″ thicknesses in double layer constructions.

Asbestos Paper and Roll Board. Used where insulation of minimum thickness is required, principally as a protection against heat and as a fire-retardant. Also used for wrapping hot-air heater pipes although for this purpose several wraps are always necessary. Paper is furnished 18″, 24″ and 36″ wide in thicknesses from 0.015″ to 1/16″. Roll Board (heavy asbestos paper) is furnished 18″ and 36″ wide in 3/32″ and ⅛″ thicknesses. Both are supplied in standard rolls weighing 50 or 100 lb. Special widths and cut sheets supplied on order. A 12-lb. Asbestos Paper Tape is available in standard rolls 84 ft. long and 2″ or 3″ wide. Packages of 2″ tape contain 18 rolls and of 3″ tape, 12 rolls.

Asbestos Sheet Millboard. Recommended where relatively thin sheets or boards are required for protection against fire, heat, and acid fumes. Used as a fireproof lining for partitions, elevator shafts, etc. Also used in ranges, stoves, gas-grate backs, etc. Made in various densities and fire-resisting properties. Furnished 1/32″ to ¾″ thick in standard sheets 42″ x 48″ or in cut pieces.

Asbestos Roll Fire-Felt (Temperature limit, 1000 deg. F.). A soft, flexible asbestos felt that may be folded, bent or wrapped around pipes and heated surfaces. Furnished 3/32″, ⅛″, 3/16″ and ¼″ thick in rolls 3 ft. wide, containing approximately 100 sq. ft.

Banroc Blankets (For temperatures to 1000 deg. F.). Composed of Banroc (rock wool) felted between various metal fabrics, such as galvanized wire netting, copper-bearing metal lath, rib lath, and fly-screen wire. Can also be furnished with asbestos paper both sides, as well as with a sheet iron outside jacket, depending upon the insulating purpose for which it is to be used. Standard sizes for most types of blankets are 24″ x 96″ and 24″ x 48″, from 1″ to 6″ thick.

Standard Hair Felt (Temperature limit, 200 deg. F.). Made from 100% selected cattle hair and adapted to a wide variety of insulation requirements at low or moderate temperatures. Furnished from ¼″ to 2″ thick in bales 6 ft. x 50 ft., 3 ft. x 100 ft., 3 ft. x 50 ft., 9 ft. x 50 ft. and in cut pieces.

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Sil-O-Cel Insulating Brick

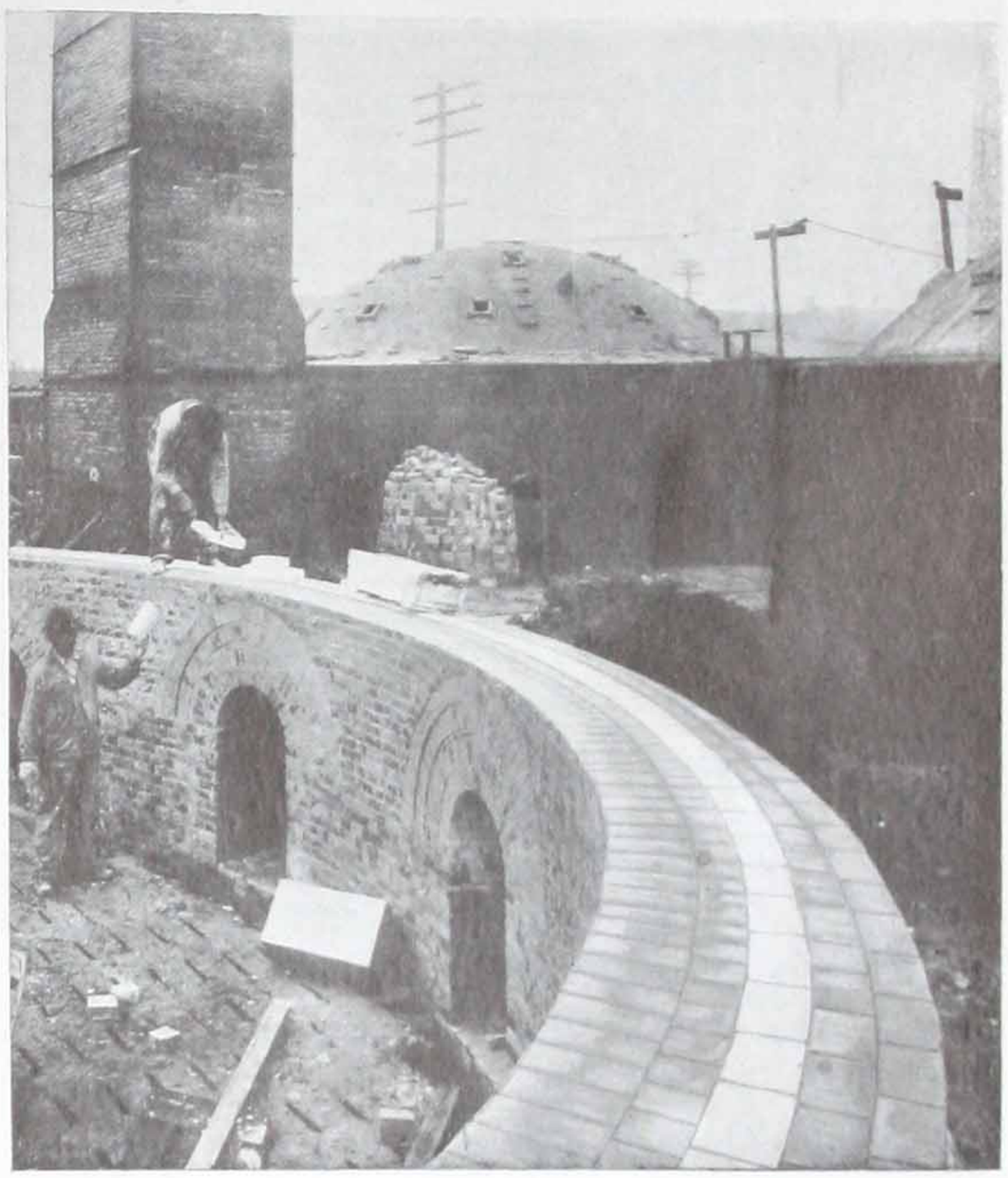
There are three types of Sil-O-Cel Insulating Brick: Sil-O-Cel Super Brick (calcined) for temperatures as high as 2500 deg. F., Sil-O-Cel C-22 Brick (calcined) for temperatures up to 2000 deg. F., and Sil-O-Cel Natural Brick for temperatures to 1600 deg. F. These three types of Sil-O-Cel brick are used behind fire brick linings in boilers, still furnaces, heat treating furnaces, kilns and other types of high temperature equipment. Sil-O-Cel C-22 Brick are also used as a refractory, without fire brick protection, as an inner lining in high temperature furnaces to replace fire brick. More detailed discussion of this use of C-22 Brick will be found on another data sheet.

All types of Sil-O-Cel brick are furnished in standard fire brick size, 9″ x 4½″ x 2½″, and in other fire brick shapes, as ordered. They are packed in fibre cartons containing twenty-five 9″ straight brick or an equivalent volume of other sizes. Shapes available include those in the following list:

2″ brick	No. 1, 2 and 3 wedge	edge skew	No. 1, 2 and 3 neck
3″ brick	No. 1, 2 and 3 arch	end skew	circle, splits, soaps
feather edge	No. 1, 2, 3 and 4 key	side skew	chamferred

A special Sil-O-Cel Mortar of high insulating value is furnished with the brick at the rate of 80 lb. per thousand brick, at a slight additional charge. Using this mortar insures a wall of practically the same insulating value throughout. It is shipped in bags of approximately 80 lb.

When Sil-O-Cel C-22 Brick are used as a refractory, C-22 Cement should be employed for setting. This cement is supplied ready-mixed in containers of convenient sizes. Approximately 300 lb. are required per thousand brick for a dipped, rubbed joint.



"Core wall" of Sil-O-Cel Natural Brick in down-draft brick kiln for firing refractories

Sil-O-Cel Natural Brick

For temperatures to 1600 deg. F.

Sil-O-Cel Natural Brick are cut from the pure mineral Celite. They will serve indefinitely at temperatures up to 1600 deg. F. without loss of effectiveness. This type of Sil-O-Cel brick is the most efficient insulating brick obtainable and is used in preference to other types of Sil-O-Cel brick except where very severe temperatures are encountered.

Sil-O-Cel Natural Brick have a crushing strength of about 400 lb. per sq. in., equivalent to 29 tons per sq. ft., and so are amply strong for structural purposes. They should not be used as bonds, however, and fire brick, red brick, or metal bonds should always be used where bonding of walls is necessary.

Sil-O-Cel Natural Brick are sized after cutting so that accurate, smooth surfaces are assured. This enables the brick to be laid up with thin joints and permits bonding with the fire brick where required.

Sil-O-Cel Natural Brick of the size 9″ x 4½″ x 2½″ weigh approximately 1¾ lb. each; the shipping weight, including fibre cartons and Sil-O-Cel Mortar, being about 1900 lb. per thousand 9″ straight brick.

Sil-O-Cel C-22 Brick

For temperatures to 2000 deg. F.

Sil-O-Cel C-22 Brick are highly efficient insulating refractory brick, calcined for direct exposure to furnace temperatures. They are recommended up to 2000 deg. F. as a refractory lining to replace fire brick in oil and gas-fired furnaces and electric furnaces of the resistance type, but not where they will be subject to mechanical abrasion or slag action.

This combining of the refractory and insulating course not only results in a saving in construction costs, but also cuts down the heat storage capacity of the masonry.

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Outside wall of Cross Cracking Unit being insulated with 4½" of Sil-O-Cel C-22 Brick in "core wall" construction

C-22 Brick have a heat capacity less than 1/3 that of fire brick, which effects a highly important economy on intermittent furnaces. Less heat is wasted when the furnace is shut down and the furnace can be brought up to temperature again in a very short time, with minimum expense for heat.

In preventing transmitted heat loss, C-22 Brick are three to four times as effective as fire brick in retarding heat flow through furnace walls.

Additional savings accrue because of the low permeability of C-22 Brick. With a permeability which closely approaches that of fire brick, no wash coating of cement is necessary to seal the face of the brick.

Where furnace temperatures are above 2000 deg. F. or surface erosion is severe, Sil-O-Cel C-22 Brick are used as insulation behind fire brick linings where the temperature on the insulation will be as high as 2000 deg. F.

Sil-O-Cel C-22 Brick have a crushing strength of about 700 lb. per sq. in., equivalent to over 50 tons per sq. ft. While this is ample for structural purposes, they should not be used as headers in bonding walls except in cases where they are used as a veneer wall.

Sil-O-Cel C-22 Brick are furnished true to size within the limits prescribed for No. 1 fire brick. This makes possible correct bonding with the fire brick.

Sil-O-Cel C-22 Brick weigh approximately 2¼ lb. each; the shipping weight, including fibre cartons and Sil-O-Cel Mortar, being about 2510 lb. per thousand 9″ straight brick.

In addition to its other uses, Sil-O-Cel C-22 Bric are often used as the outside course in the com bustion zone and first pass of water-tube boilers. The are also used as a combination insulating and fac brick course on the outside of bake ovens and simila equipment where an exterior wall of pleasing appear ance and wear-resisting properties is desired.

Sil-O-Cel Super Brick

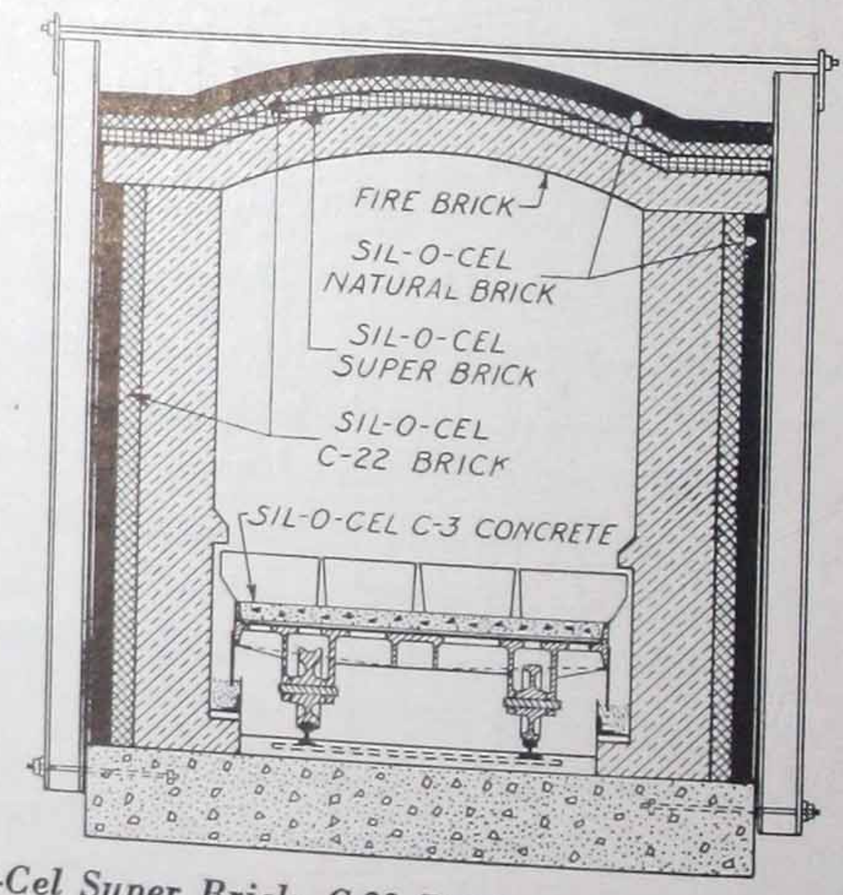
For temperatures to 2500 deg. F.

Sil-O-Cel Super Brick (U. S. Patent No. 1,544,433) are a calcined type of Sil-O-Cel brick designed for exceptionally severe insulating service where subjected to temperatures behind the refractory in excess of 2000 deg. F. They can be used where they will come in contact with temperatures up to 2500 deg. F.

They have a crushing strength of 350 lb. per sq. in., equivalent to 25 tons per sq. ft. While this is ample for structural purposes, they should not be used as headers in bonding walls, except where they are used in veneer wall construction.

Sil-O-Cel Super Brick weigh about 2¼ lb. each; the shipping weight, including the fibre cartons and Sil-O-Cel Mortar, being approximately 2510 lb. per thousand 9″ straight brick.

In many cases it is possible to cut down on the thickness of first-quality fire brick when Sil-O-Cel Super Brick are used. For instance, in equipment where Sil-O-Cel Natural Brick would be used behind 13½″ of fire brick, Sil-O-Cel Super Brick could be safely used back of 9″, or in some cases as low as 4½″ of refractory, introducing a considerable saving.



Sil-O-Cel Super Brick, C-22 Brick and Natural Brick as combination insulation on high temperature tunnel kiln

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JM-20 Insulating Brick

For temperatures to 2000 deg. F.

The demand for a lower cost, lower conductivity insulating refractory brick, which also possesses the other necessary physical properties, resulted in the development of the JM-20 Insulating Brick, which has met with favorable reception wherever furnace operating costs must be reduced.

Combining with lower cost and lower conductivity the advantages of non-shrinkage, ample heat resistance and adequate strength, JM-20 Brick embodies the characteristics essential to excellent insulating performance under the conditions for which it was specifically developed. Erection is facilitated by the ease with which it may be cut with a hacksaw. Its unusually light weight permits further economies in design and construction.

As a back-up insulation, the brick can be employed in various types of high temperature industrial equipment, such as ceramic kilns, annealing furnaces, producer-gas mains and steel plant equipment.

As an insulating refractory, JM-20 Brick is recommended for use in electric furnaces, glass lehrs, radiant tube-type annealing furnaces, muffle type furnaces or wherever no flame impingement, slag action or mechanical abrasion is present.

JM-20 Insulating Brick is composed of a high quality refractory clay and a filler consisting of specially manufactured mineral fibre. After the brick is kiln-fired at a temperature over 2000 deg. F., it is cut to accurate size.

Properties of JM-20 Insulating Brick

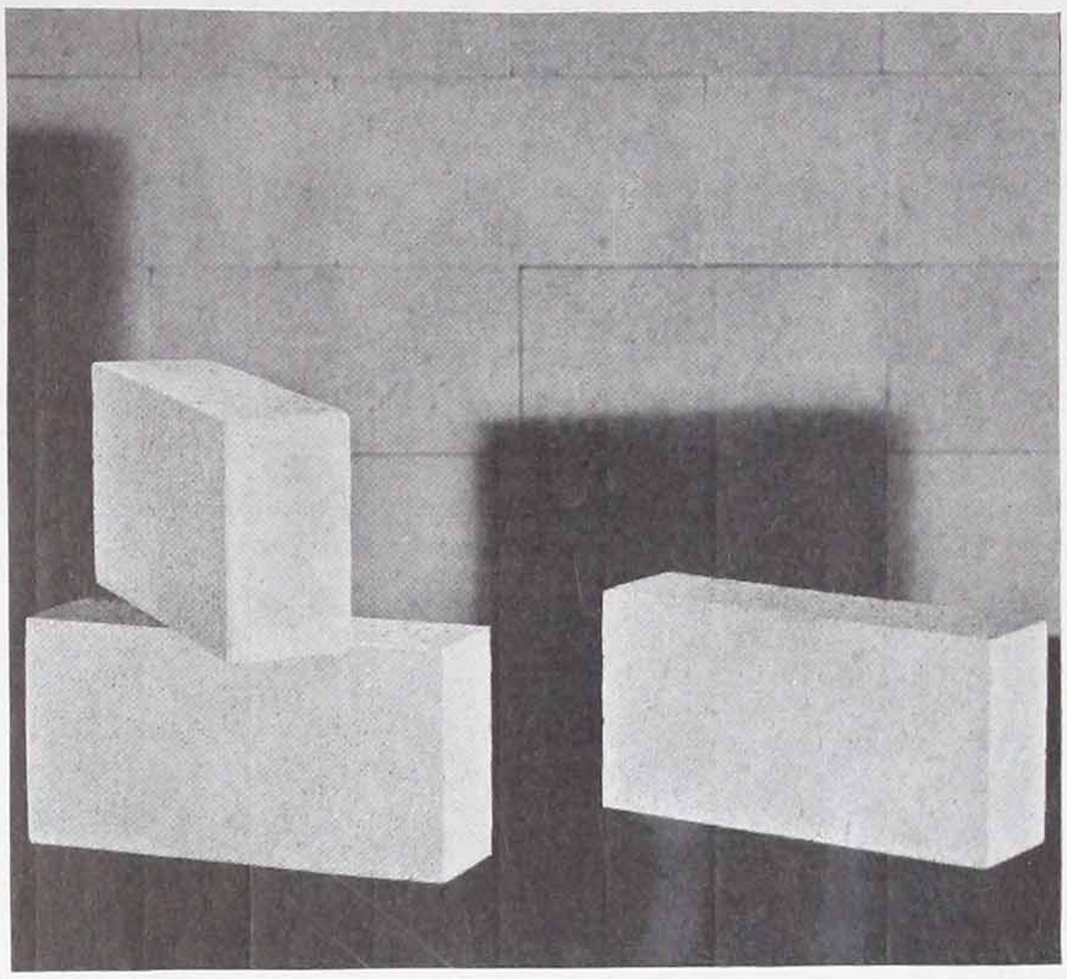
Conductivity: The thermal conductivity of JM-20 Insulating Brick expressed in B.t.u. per sq. ft., per degree temperature difference, per inch of thickness, per hour, for various mean temperatures is as follows:

Deg. F.	*400*	*600*	*800*	*1000*	*1200*	*1400*	*1600*	*1800*
B.t.u.	.830	.905	1.005	1.130	1.280	1.455	1.655	1.880

Density: The standard 9″ brick weigh 1.5 to 1.7 lb. each; 25 to 30 lb. per cu. ft.

Strength: The brick have adequate transverse and crushing strength, as well as ability to resist damage through shipping, handling and vibration.

Deformation: Under a load of 12.5 lb. per sq. in. the brick show no deformation in laboratory tests conducted at a temperature of 2100 deg. F.



Linear Shrinkage: The brick show zero shrinkage when subjected to a standard five-hour soaking temperature test at 2000 deg. F.

Linear Expansion: The percentage of expansion at various temperatures are as follows:

Deg. F.	*500*	*1000*	*1500*	*2000*
Expansion	.12%	.35%	.58%	.80%

Sizes, Shapes and Accessories

JM-20 Insulating Brick are furnished in standard fire brick size, 9″ x 4½″ x 2½″, and in other fire brick shapes as ordered. They are packed in fibre cartons containing twenty-five 9″ straight brick or an equivalent number of other sizes. Shapes available include:

2″ brick	No. 1, 2 and 3 wedge	edge skew	No. 1, 2 and 3 neck
3″ brick	No. 1, 2 and 3 arch	end skew	circle, splits, soaps
feather edge	No. 1, 2, 3 and 4 key	side skew	chamferred

For laying the brick as a back-up insulation, JM-20 Mortar is used. Approximately 200 lb. are required per thousand brick.

When JM-20 Brick is used as an insulating refractory, Hellite is employed in bonding. This cement is supplied ready-mixed in 5 and 10-lb. cans, 25 and 50-lb. pails, 100, 250, 500 and 850-lb. drums. Approximately 250 lb. are required per thousand brick for a dipped, rubbed joint.

Orders must specify whether or not mortar or cement is required.

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Transmitted heat losses through fire brick walls Bare and insulated with JM-20 Insulating Brick

Loss given in B.t.u. per sq. ft., per hour — Temperature of air, 80 d

Fire Brick thickness, inches	JM-20 Insulating Brick thickness, inches	Inside temperature, deg. F. 1000				1200				1400				1600			
		Per Deg.	Total	JM-20 Temp. Inner Surface	JM-20 Temp. Outer Surface	Per Deg.	Total	JM-20 Temp. Inner Surface	JM-20 Temp. Outer Surface	Per Deg.	Total	JM-20 Temp. Inner Surface	JM-20 Temp. Outer Surface	Per Deg.	Total	JM-20 T Inner Surface	
4½	....	1.065	980	....	....	1.127	1262	....	....	1.189	1569	....	....	1.251	1903	....	
4½	2½	.256	236	858	188	.269	301	1032	211	.282	372	1200	234	.297	451	1374	
4½	4½	.162	149	914	153	.169	189	1094	170	.178	235	1278	188	.187	284	1458	
4½	5	.148	136	922	148	.155	174	1102	164	.163	215	1288	180	.172	261	1470	
4½	7½	.104	96	944	130	.109	122	1132	141	.115	152	1322	154	.121	184	1508	
4½	9	.088	81	952	122	.092	103	1142	133	.097	128	1334	144	.103	157	1522	
4½	10	.080	74	958	119	.084	94	1148	129	.088	116	1340	139	.093	141	1528	
4½	12½	.065	60	966	112	.068	76	1158	120	.072	95	1350	129	.076	116	1542	
4½	13½	.061	56	968	110	.064	72	1160	118	.067	88	1354	126	.071	108	1546	
9	....	.602	554	....	....	.630	706	....	....	.658	869	....	....	.686	1042	....	
9	2½	.217	200	760	174	.227	254	910	194	.237	313	1062	215	.248	377	1216	
9	4½	.145	133	842	146	.151	169	1010	162	.158	209	1178	178	.166	252	1342	
9	5	.134	123	854	142	.140	157	1024	157	.147	194	1196	172	.154	234	1362	
9	7½	.097	89	894	126	.101	113	1072	137	.106	140	1252	149	.112	170	1430	
9	9	.083	76	910	120	.087	97	1092	130	.091	120	1272	141	.096	146	1454	
9	10	.076	70	918	117	.079	88	1102	126	.083	110	1284	136	.088	134	1466	
9	12½	.063	58	934	111	.066	74	1120	119	.069	91	1306	127	.072	109	1490	
9	13½	.058	53	938	108	.061	68	1124	116	.064	84	1312	124	.067	102	1498	
13½	....	.426	392	....	....	.444	497	....	....	.463	611	....	....	.481	732	....	
13½	2½	.190	175	682	164	.197	221	820	182	.205	271	956	201	.214	325	1092	
13½	4½	.132	121	782	141	.138	155	938	156	.144	190	1096	170	.150	229	1250	
13½	5	.123	113	800	137	.128	143	956	150	.134	177	1118	165	.140	213	1274	
13½	7½	.091	84	852	124	.095	106	1022	134	.099	131	1190	145	.104	158	1360	
13½	9	.079	73	872	118	.082	92	1048	128	.086	114	1220	138	.090	137	1394	
13½	10	.072	66	884	115	.075	84	1060	124	.079	104	1236	133	.083	126	1412	
13½	12½	.060	55	902	109	.063	71	1084	117	.066	87	1264	125	.069	105	1442	
13½	13½	.056	52	910	108	.059	66	1092	115	.062	82	1272	123	.065	99	1452	

Fire Brick thickness, inches	JM-20 Insulating Brick thickness, inches	Inside temperature, deg. F. 1800				2000				2200				2400			
		Per Deg.	Total	JM-20 Temp. Inner Surface	JM-20 Temp. Outer Surface	Per Deg.	Total	JM-20 Temp. Inner Surface	JM-20 Temp. Outer Surface	Per Deg.	Total	JM-20 Temp. Inner Surface	JM-20 Temp. Outer Surface	Per Deg.	Total	JM-20 Te Inner Surface	
4½	....	1.313	2261	....	....	1.375	2641	....	....	1.437	3043	....	....	1.499	3478	....	
4½	2½	.313	538	1542	281	.331	636	1708	306	.350	742	1874	331	....	....	....	
4½	4½	.198	341	1636	224	.210	403	1814	244	.222	471	1992	263	....	....	....	
4½	5	.181	311	1650	214	.192	369	1830	233	.204	433	2010	253	....	....	....	
4½	7½	.128	220	1694	182	.136	261	1880	197	....	....	....	....	....	....	....	
4½	9	.109	188	1710	169	.115	221	1898	182	....	....	....	....	....	....	....	
4½	10	.099	170	1718	162	.105	202	1908	175	....	....	....	....	....	....	....	
4½	12½	.080	138	1734	149	.085	163	1924	159	....	....	....	....	....	....	....	
4½	13½	.075	129	1738	145	.080	154	1930	155	....	....	....	....	....	....	....	
9	....	.714	1229	....	....	.742	1425	....	....	.770	1635	....	....	.798	1852	....	
9	2½	.260	447	1362	257	.272	522	1510	277	.285	604	1654	299	.298	691	1792	
9	4½	.175	301	1512	211	.184	353	1676	228	.194	411	1838	246	.204	473	1994	
9	5	.162	279	1534	204	.170	326	1700	219	.179	379	1866	236	....	....	....	
9	7½	.118	203	1606	175	.124	238	1782	189	.131	278	1956	203	....	....	....	
9	9	.101	174	1634	164	.107	205	1812	176	.113	240	1990	189	....	....	....	
9	10	.093	160	1648	158	.098	188	1828	169	.103	218	2008	181	....	....	....	
9	12½	.076	131	1676	145	.081	156	1860	156	....	....	....	....	....	....	....	
9	13½	.071	122	1684	141	.075	144	1870	151	....	....	....	....	....	....	....	
13½	....	.500	860	....	....	.518	995	....	....	.537	1139	....	....	.555	1288	....	
13½	2½	.223	384	1226	238	.232	445	1360	256	.242	513	1492	275	.252	585	1616	
13½	4½	.157	270	1406	200	.164	315	1558	216	.172	365	1712	232	.180	418	1856	
13½	5	.146	251	1434	193	.153	294	1590	209	.160	339	1744	223	.168	390	1892	
13½	7½	.109	188	1530	169	.115	221	1696	182	.121	257	1862	196	....	....	....	
13½	9	.095	163	1566	159	.100	192	1736	171	.105	223	1906	183	....	....	....	
13½	10	.087	150	1584	154	.092	177	1758	165	.097	206	1930	176	....	....	....	
13½	12½	.072	124	1620	142	.076	146	1800	152	.081	172	1974	163	....	....	....	
13½	13½	.068	117	1634	139	.072	138	1812	149	.076	161	1992	158	....	....	....	

The surface temperatures above are approximate and are based upon average surface conditions where the surface is fre radiating to still air at 80 deg. F. Moving air, proximity of other objects and variations in the nature of the surface will aff these temperatures.

Printed in U. S.

Asbesto-Sponge Felted Sheets and Blocks

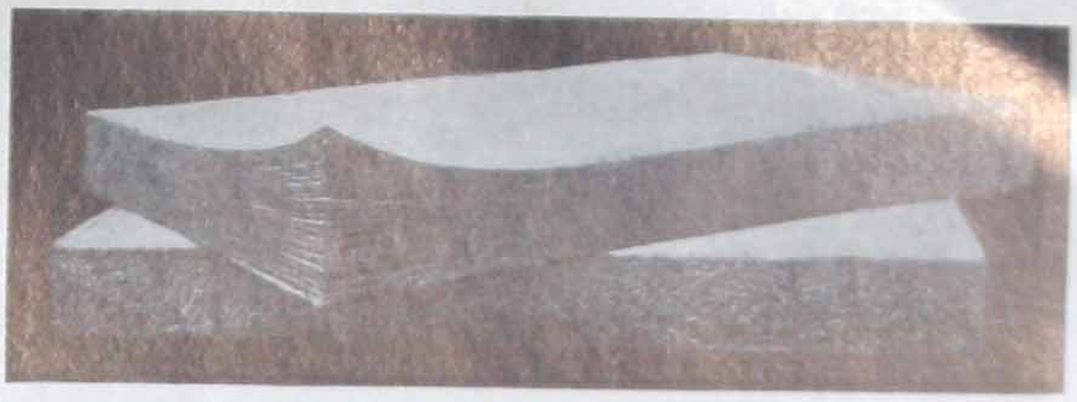
For temperatures to 700 deg. F.

Asbesto-Sponge Felted sheets and blocks are an exceptionally efficient insulating material for application to surfaces with temperatures up to 700 deg. F. especially where severe service conditions prevail.

The principal advantages of this material over other types of insulation lie in its high insulating efficiency and its durability in service. Vibration and shock have little effect upon Asbesto-Sponge Felted; soaking it in water and then drying it out again leaves the material unchanged in structure and efficiency.

Constructed from felts composed of asbestos fibre and small particles of spongy cellular material, Asbesto-Sponge Felted is built up to the required thickness in laminations, cemented together at intervals and averaging approximately 40 layers per inch of thickness. The enormous number of surface resistances offered by such a construction provides the unusual efficiency found in this material.

The felted nature of Asbesto-Sponge Felted affords it considerable toughness. Consequently, rough usage does not cause breaking, crumbling or loss of efficiency. This material is so resistant to handling and the various forms of deterioration that it can be removed and replaced without impairing its insulating value or losing its structural strength.



The pasting strips by which the laminations of the felt are bound together run the length of the sheet or block, and thus permit considerable flexibility for easy application to curved surfaces, such as boilers or tanks, without the necessity of special shapes for each required radius. If desired, these strips can be applied across the sheet or block, but such change must be specifically stated in the order.

The weight of Asbesto-Sponge Felted is approximately 2½ lb. per sq. ft., per inch of thickness. It is furnished 36″ long by 6″, 9″, 12″, 18″, 24″ and 36″ wide, from ½″ to 4″ thick.

The material is also furnished in sectional pipe insulation form as described on another data sheet.

Asbesto-Sponge Felted Sheets and Blocks Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot, per degree temperature difference, per hour.
Efficiency expressed in percent of bare surface losses.

Insulation thickness, inches		Temperature of surface—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between surface and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
1	Heat Loss, B.t.u.	.333	.341	.350	.360	.369	.379	.389	.399	.409	.420
	Efficiency %	82.91	84.16	85.41	86.50	87.50	88.37	89.27	90.11	90.84	91.46
1½	Heat Loss, B.t.u.	.236	.242	.248	.254	.261	.268	.275	.283	.290	.298
	Efficiency %	87.88	88.76	89.67	90.47	91.15	91.78	92.42	92.99	93.50	93.94
2	Heat Loss, B.t.u.	.183	.187	.192	.197	.203	.208	.214	.220	.226	.232
	Efficiency %	90.65	91.31	92.02	92.61	93.12	93.61	94.10	94.55	94.94	95.29
2½	Heat Loss, B.t.u.	.149	.153	.157	.161	.166	.170	.175	.179	.184	.189
	Efficiency %	92.36	92.89	93.46	93.96	94.39	94.79	95.19	95.55	95.88	96.16
3	Heat Loss, B.t.u.	.126	.129	.132	.136	.140	.144	.148	.152	.156	.160
	Efficiency %	93.54	94.01	94.48	94.90	95.26	95.58	95.92	96.23	96.51	96.75
3½	Heat Loss, B.t.u.	.109	.112	.115	.118	.121	.125	.128	.132	.135	.139
	Efficiency %	94.41	94.81	95.21	95.56	95.88	96.18	96.47	96.74	96.97	97.18
4	Heat Loss, B.t.u.	.096	.098	.101	.104	.107	.110	.113	.116	.119	.122
	Efficiency %	95.07	95.43	95.78	96.09	96.37	96.63	96.89	97.12	97.33	97.52

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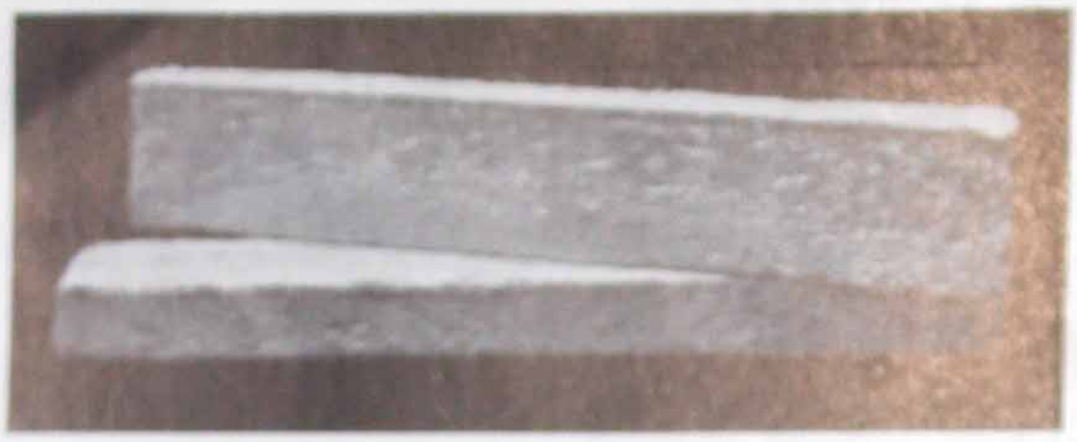
J-M 85% Magnesia Blocks and Lagging

For temperatures to 600 deg. F.



J-M 85% Magnesia blocks and lagging are used to insulate flat, curved or irregular surfaces where temperatures do not exceed 600 deg. F.

This material is particularly adapted to conditions where high insulating value and light weight are needed or where surfaces are so irregular that an easily cut insulation is required for proper fitting. It is composed of hydrated basic carbonate of magnesia bonded with asbestos fibre, moulded and machined into block form.

Unless this material is protected by some material with greater heat-resisting qualities, it should not be applied to surfaces the temperatures of which exceed 600 deg. F. Often it is used at much higher operating temperatures outside a layer of Superex which possesses high heat-resistance. Such a construction is known as Superex Combination Insulation and is further described in connection with Superex blocks.

J-M 85% Magnesia is furnished in flat blocks 3", 6" and 12" wide and 18" or 36" long. Other sizes can be supplied on special order. Available thicknesses include all from 1" to 4" in increments of ⅛". The 12" blocks are not made under 1½" thick.

Curved blocks are furnished in the same sizes as flat blocks with a minimum thickness of 1¼". The maximum thickness is that which can be cut from a 4"-thick flat block. The radius of curvature which the blocks must fit should be specified on the order.

J-M 85% Magnesia weighs approximately 1.4 lb. per sq. ft., per inch of thickness.

It is also furnished in sectional pipe insulation form as described on another data sheet.

*Number of 85% Magnesia blocks per carton**

Thickness	Flat blocks 6" x 36"	Flat blocks 12" x 36"	Curved blocks 6" x 36"
1"	36	—	—
1¼"	28	—	28
1⅜"	26	—	26
1½"	24	12	24
1¾"	20	10	20
2"	18	9	18
2¼"	16	8	16
2½"	14	7	14
2¾"	12	6	12
3"	12	6	12
4"	9	4	9

* The gross weight of a standard carton of 85% Magnesia blocks and lagging is approximately 75 lb. Standard cartons are 18⅝" x 12⅝" (or 13") x 36¼". For curved blocks cartons are a fraction of an inch larger and for small or odd lots the carton size is 12⅝" x 6¾" x 36¼".

Heat losses and efficiencies of J-M 85% Magnesia Blocks and Lagging

Heat losses expressed in B.t.u. per square foot, per degree temperature difference, per hour.
Efficiency expressed in percent of bare surface losses.

Insulation thickness, inches		Temperature of surface—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between surface and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
1	Heat Loss, B.t.u.	.374	.380	.386	.393	.399	.405	.411	.418	.425	.432
	Efficiency %	80.82	82.34	83.92	85.25	86.48	87.57	88.67	89.65	90.47	91.22
1½	Heat Loss, B.t.u.	.268	.271	.275	.280	.284	.288	.292	.296	.301	.306
	Efficiency %	86.25	87.40	88.54	89.50	90.38	91.16	91.95	92.66	93.26	93.78
2	Heat Loss, B.t.u.	.208	.211	.214	.217	.221	.224	.228	.231	.234	.238
	Efficiency %	89.33	90.19	91.08	91.85	92.52	93.13	93.70	94.28	94.76	95.16
2½	Heat Loss, B.t.u.	.171	.173	.175	.178	.181	.183	.186	.189	.192	.196
	Efficiency %	91.20	91.96	92.71	93.32	93.87	94.38	94.87	95.32	95.70	96.04
3	Heat Loss, B.t.u.	.145	.146	.148	.150	.153	.155	.157	.159	.162	.165
	Efficiency %	92.56	93.22	93.84	94.37	94.82	95.24	95.67	96.06	96.37	96.65
3½	Heat Loss, B.t.u.	.125	.127	.129	.131	.133	.135	.137	.139	.141	.143
	Efficiency %	93.59	94.11	94.62	95.08	95.49	95.86	96.22	96.55	96.84	97.09
4	Heat Loss, B.t.u.	.110	.112	.113	.115	.117	.119	.121	.123	.124	.124
	Efficiency %	94.36	94.79	95.29	95.68	96.03	96.35	96.66	96.95	97.22	97.46

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Superex Blocks

For temperatures to 1900 deg. F.

Superex block insulation is made from specially selected, calcined diatomaceous silica, blended and bonded with asbestos fibre. The resulting product combines the essential characteristics of high heat resistance and exceptional insulating qualities. It is the most generally adaptable material for use where insulation must resist temperatures between 600 and 1900 deg. F.

Superex has a low thermal conductivity and safely withstands the temperatures in this range with negligible shrinkage. Although it weighs only approximately 24 lb. per cu. ft., this material possesses ample strength for all purposes for which it is recommended.

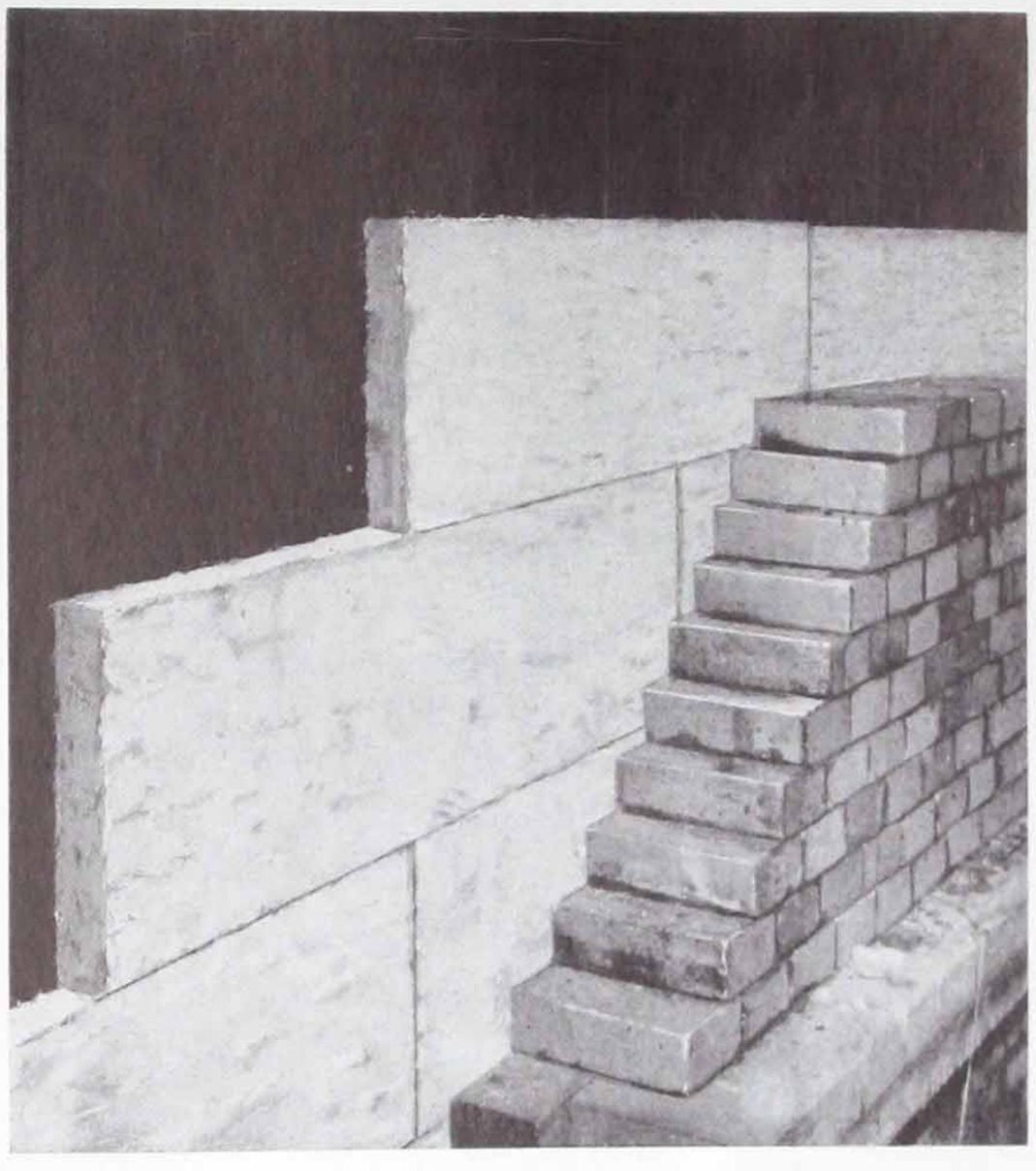
Thicknesses: Flat blocks are furnished from 1″ to 4″ thick in increments of ⅛″. For curved blocks, the minimum thickness is 1½″ and the maximum is that which can be cut from a 4″-thick flat block. The radius of curvature which curved blocks must fit should be specified on the order.

Widths: Standard widths are 3″, 6″ and 12″. The 12″ blocks cannot be made under 1½″ thick.

Lengths: Standard lengths are 18″ and 36″. Other lengths up to 42″ may be ordered at no extra charge.

This material is also furnished for pipe insulation as described on another data sheet.

Superex blocks are used generally in stationary and marine power plant practice, in industrial and metallurgical furnaces and ovens, regenerators, kilns, roasters, high temperature mains, flues and stacks. The large-size blocks are especially economical in handling and labor of erection. By applying the insulation in double layer, through joints can be eliminated and heat loss reduced accordingly. Often the double layer



work can economically be made to consist of Superex Combination Insulation, as described in the following:

Superex Combination Insulation

Insulating materials having a high refractory value are generally lower in insulating value. It is also usual that materials for higher temperatures are more expensive. The proper insulation for a given application is one which has a refractory value high enough to withstand the temperature requirements, yet which also has high insulating value and is satisfactory in other respects.

If the drop in temperature through the first layer of insulation is sufficient, then, for the second layer, a material of lesser refractory value but of greater efficiency and lower cost may be used.

Combinations of insulation generally consist of Superex and Magnesia or Superex and Asbesto-Sponge Felted. These combinations give greater insulating efficiency and heat resistance for a given insulation thickness. The Superex is always used next to the hot surface as a protection for the other insulation, which, though high in insulation value, is comparatively low in heat resistance. The proper combination and thickness is usually governed by the maximum operating temperature, average operating

*Number of Superex blocks per carton**

Thickness	Flat blocks 6″ x 36″			Flat blocks 12″ x 36″			Curved blocks 6″ x 36″		
	M	W	R	M	W	R	M	W	R
1″	30	30	36	—	—	—	—	—	—
1¼″	24	24	28	—	—	—	—	—	—
1½″	20	20	24	10	10	12	20	20	64
1¾″	16	16	20	8	8	10	16	16	52
2″	14	14	18	7	7	9	14	14	48
2½″	12	12	14	6	6	7	12	12	36
3″	10	10	12	5	5	6	10	10	32

M=Manville, N. J.; W=Waukegan, Ill.; R=Redwood City, Cal.

*Shipping cartons are approximately 15″ x 12″ x 36¼″. Dimensions may vary a few inches depending upon the size, thickness and shape of blocks. Cartons for small or odd lot shipments are 12⅜″ x 6¾″ x 36¼″. The weight of cartons is approximately 3½ lb. Curved blocks from Redwood City are shipped in crates weighing approximately 38 lb.

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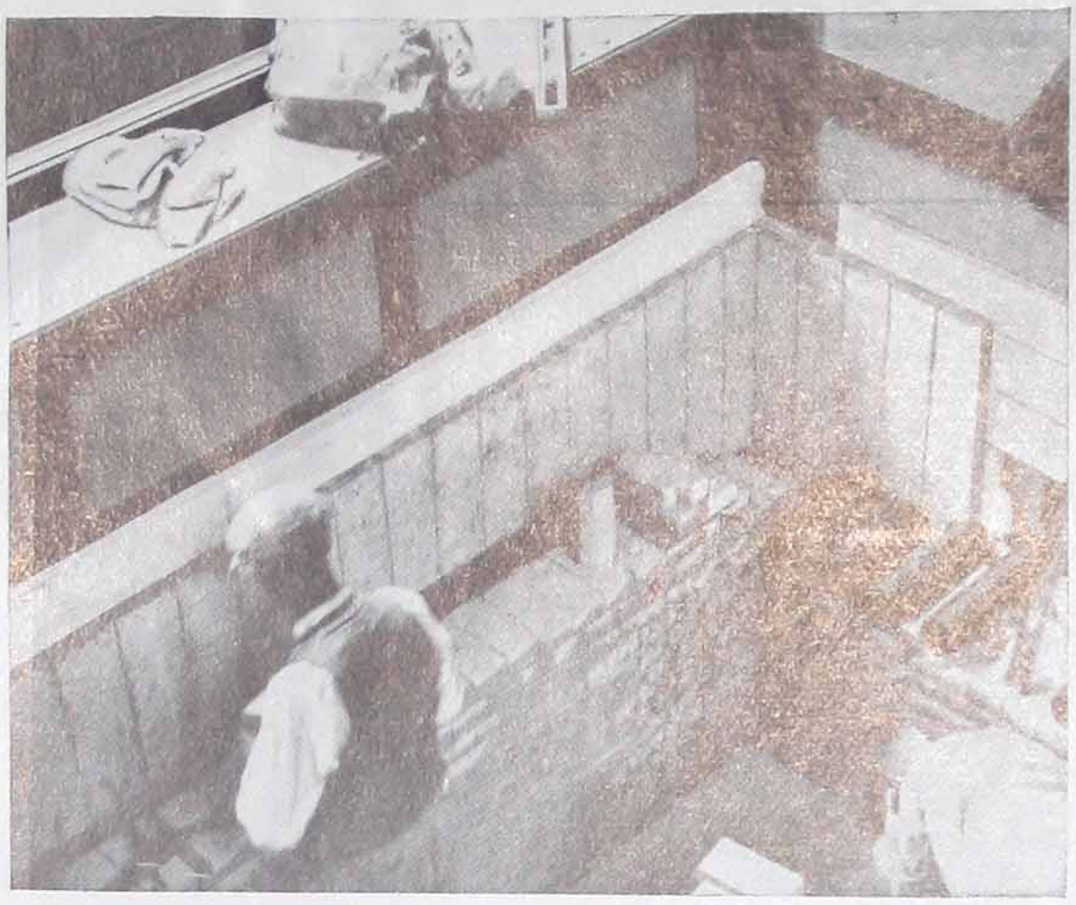


Superex Combination Insulation, 3½" thick, applied between Transite casing and fire brick in Gyro Process Tube Still

temperature, cost of heat and degree of temperature control required. This information permits a determination of the correct thickness of the inner layer to resist temperature and the total economic thickness of insulation to accomplish the desired purpose.

In computing an individual job, the necessary thickness of Superex to protect the outer layer of insulation would be figured on the basis of maximum temperature on the inner face of the Superex. The thickness of the outer layer would then be figured so that the total heat lost through the insulation would be only that portion which might not economically be saved.

The figures in the following table for Superex Combination Insulation over metal surfaces are approximations based on conditions commonly found in practice. In order to use the table it is only necessar to select the insulation combination which correspond to the maximum temperature to be applied to the ir ner surface of Superex in service.

Where a greater thickness of insulation than tha given in the table is used, the relative thickness o Superex to Magnesia or Asbesto-Sponge Felted shoul not be less than the proportions shown. The usua finish over the insulation is hard finish asbestos ce ment, ½" thick. If the cement finish is used out doors, either the last ¼" of cement is replaced wit Insulkote or an additional ¼" of Insulkote is ap plied over the ½" thick cement.

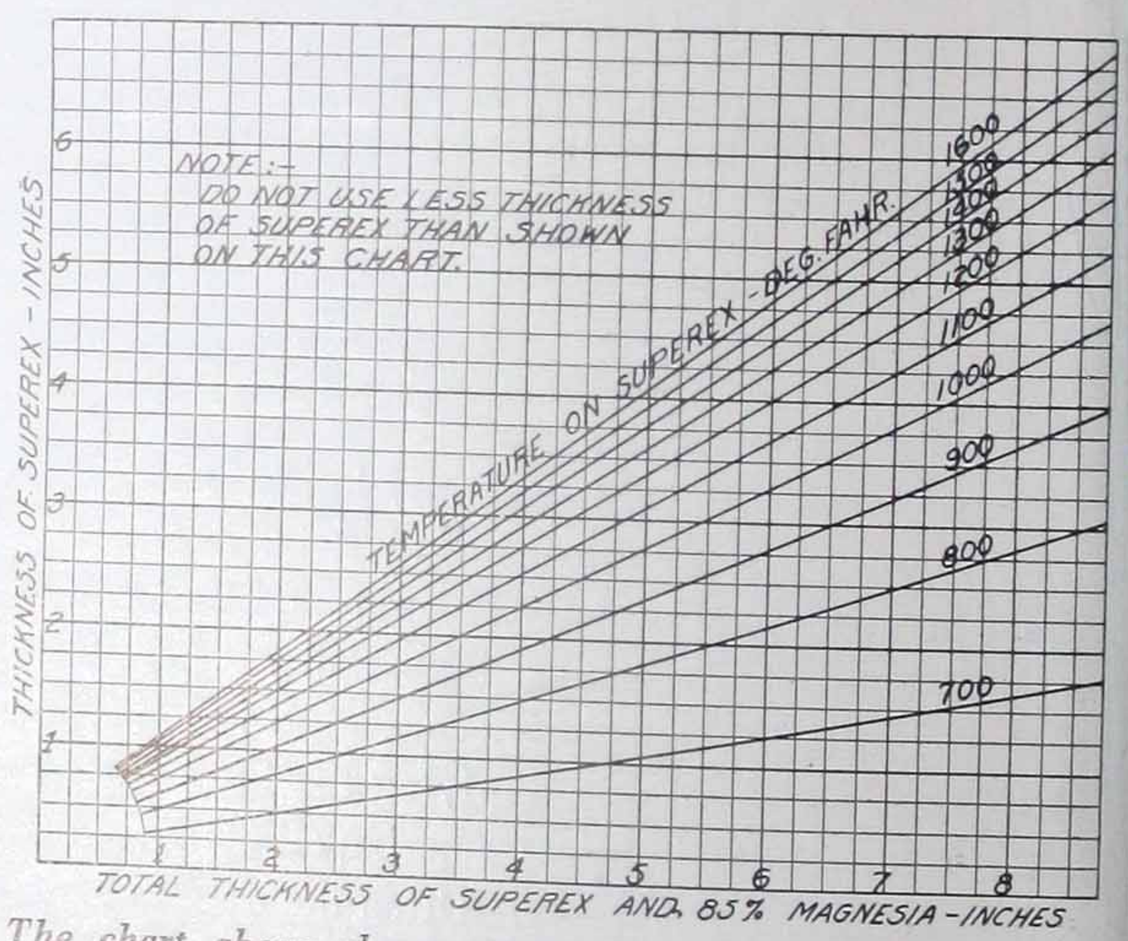
Superex Combination Insulation is also furnished for application to pipes, but is not used on pipes smaller than 2". High temperature lines, 1½" and smaller, are insulated with a single layer of Superex.

Recommended thickness of block insulation on metal surfaces

Maximum temperature on Superex, deg. F.	Thickness of Superex, inches	Thickness of Asbesto-Sponge Felted or 85% Magnesia, inches	Total thickness of block insulation, inches
300	.....	2	2
400	.....	2½	2½
500	.....	3	3
600	.....	3½	3½
750	1½	2½	4
900	2*	2*	4
1000	2½*	2*	4½
1200	3½	1½	5

*Where Asbesto-Sponge Felted is used as the second layer at operating temperatures of 750 to 1000 deg. F., the Superex may be ½" thinner and the Asbesto-Sponge Felted ½" thicker than shown above.

See also more complete tables on the reverse of Data Sheet IN-41.



The chart above shows proper proportional thickness of Superex and Magnesia for flat surfaces. (For temperatures on the Superex between 1600 deg. F. and 1900 deg. F., the use of Superex without Magnesia is recommended)

Furnace Insulation:

The same principles of combination insulation apply to the insulating of furnaces as to metal surfaces, except that brickwork has appreciable resistance in itself to the flow of heat. This changes the economic thickness of insulation and also introduces another factor which affects the thickness of Superex to be used, namely, the increasing of temperature on the Superex materially above the temperature of the brick exterior if uninsulated.

In this class of work it is also sometimes necessary to restrict the thickness of Superex when used alone.

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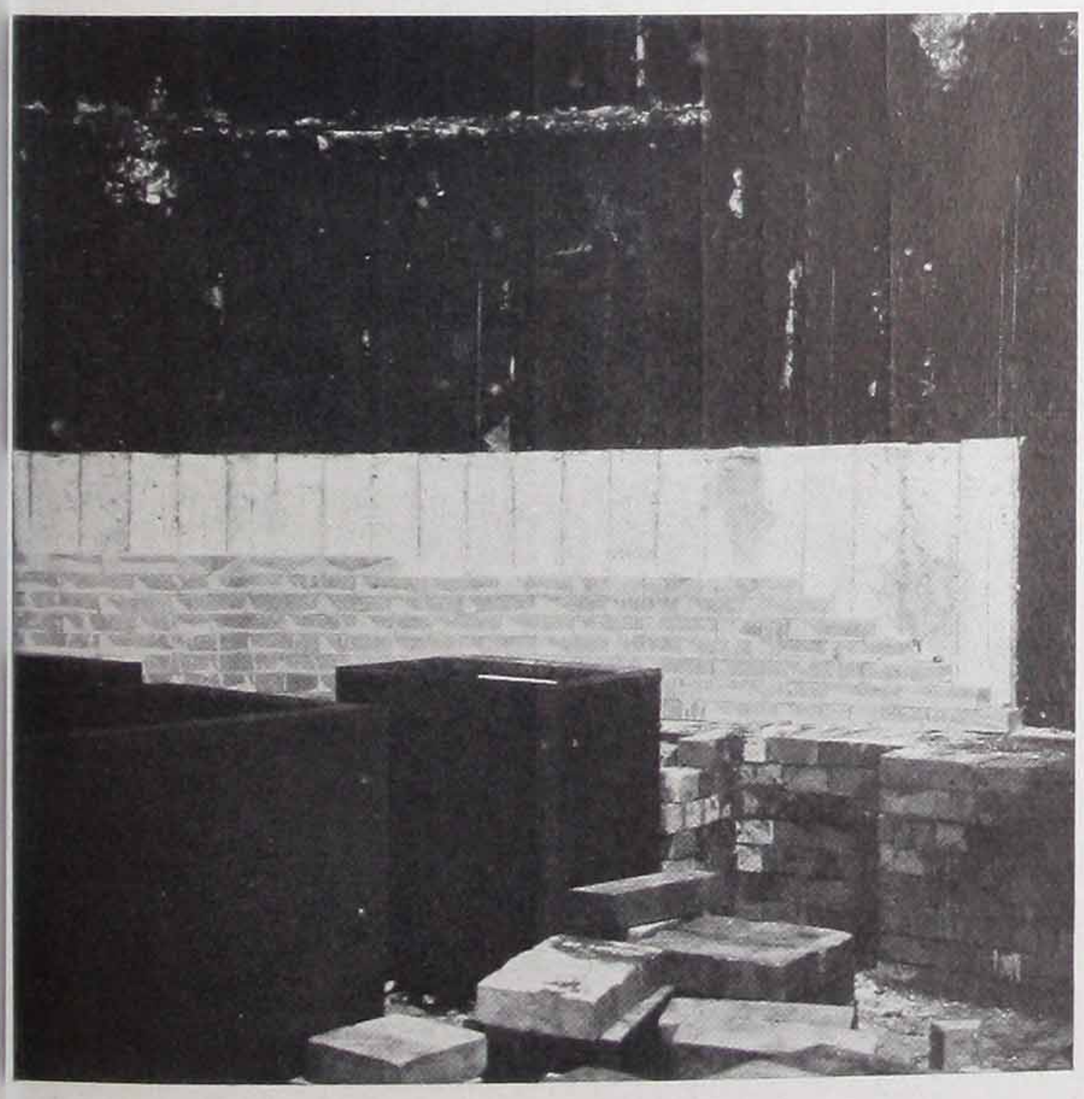
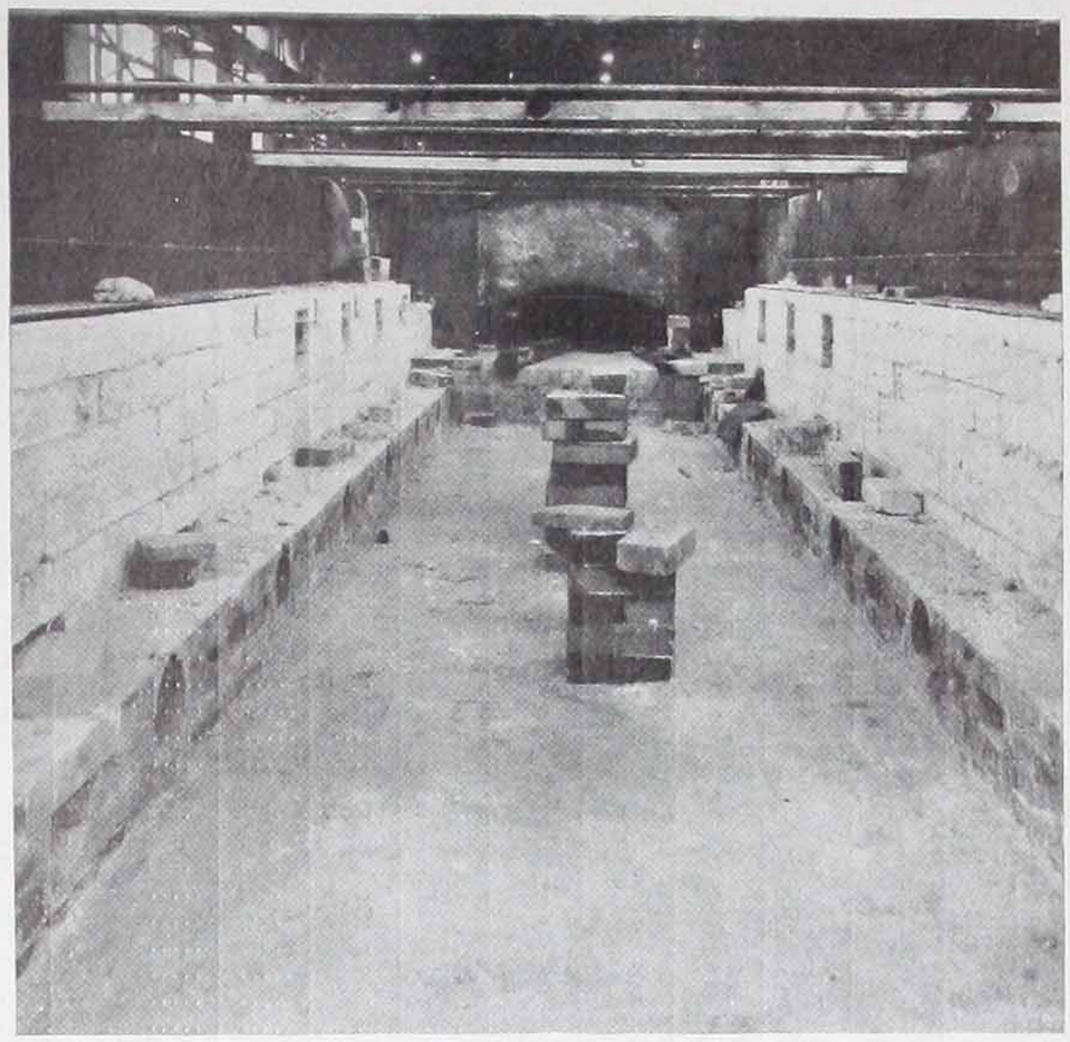
This is to avoid exceeding temperature limit of the insulation. Where the use of brick shapes is advantageous, Sil-O-Cel Natural Brick are used instead of Superex Blocks in the range up to 1600 deg. F. Sil-O-Cel C-22 Brick and Sil-O-Cel Super Brick are used to take care of insulating requirements where temperatures higher than 1900 deg. F. will be applied to the insulation. Sil-O-Cel C-22 Brick, used as a direct refractory to replace fire brick, is discussed on other data sheets.

Furnace insulation is a highly profitable investment from the standpoint of heat saving alone. Added to this is the lessening of internal strains and reduction in spalling because of the smaller temperature differential between the inside and outside of the refractory. Wall cracks, caused by uneven expansion and contraction, are fewer and smaller. Properly applied, the insulation tends to seal cracks in furnace walls and prevents infiltration of air or the extrusion of furnace gases.

When insulation is placed over the exterior of furnace brickwork, resistance is introduced in the path of heat flowing directly to the outside. This promotes heat flow along the walls, and cooler portions of the furnace are raised to a higher temperature. Sharp temperature changes are obviated and adjacent brickwork is protected against widely varying rates of expansion. Lower temperatures may be used in the heating zone and adequate temperatures still be maintained throughout all portions of the furnace setting. This saves fuel and further prevents rapid deterioration of the refractories.



Erecting the lining in a hot blast stove. Superex blocks are laid against the shell, and Sil-O-Cel C-22 Brick and fire brick built up inside



Surface Combustion drawing furnace at automobile factory, being insulated with Superex Combination Insulation

The modern furnace wall is cased with Transite sheets or with steel plate. Care is taken to leave the main supporting steel sufficiently exposed to the air so that its strength will not be affected by the heat.

It has been found entirely satisfactory to apply Superex and Magnesia blocks and Sil-O-Cel brick between the refractory and buckstays except at places of unusual thrust, such as opposite a sprung arch, or where castings and steel work are hung into the brickwork. In such locations the fire brick is carried through the insulation to the outside of the furnace.

When it is expedient to erect the furnace brickwork before the casing is applied, a space equivalent to the thickness of the insulation is left between the outside face of the brick and the inside face of the buckstays. Then insulating blocks or bricks are erected to fill this space and the Transite casing secured flush with the back of the buckstays by steel battens and toggle bolts or other suitable means.

Where the furnace brickwork is erected flush with the back of the buckstays, light angles may be clipped or spot-welded to the buckstays to allow the application of insulation between vertical steel members. These angles serve to support the 3/8" Transite casing.

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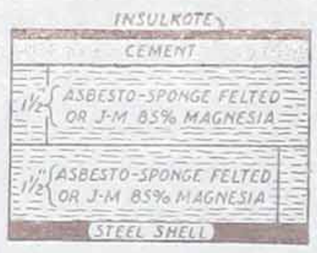
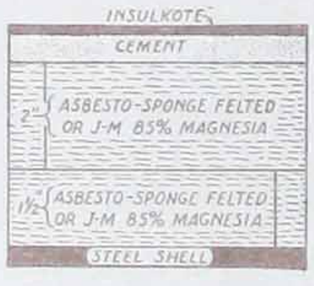
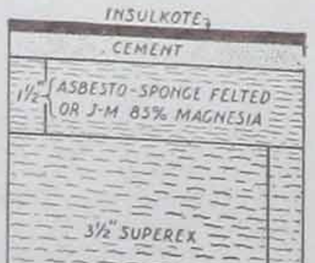
Transmitted heat losses through uninsulated and insulated construction

Fire Brick Walls¶

Thickness of fire brick, in.	Thickness of Superex, in.	B.t.u. per square foot, per degree temperature difference, per hour. Inside temperature, deg. F. 1000	1200	1400	1600	1800	2000	2200	2400	2600
4½	none	1.065	1.127	1.189	1.251	1.313	1.375	1.437	1.499	1.561
4½	1½	.300	.311	.322	.333	.344	.355	.366	.....	.....
4½	2	.243	.251	.259	.267	.276	.285	.295	.....	.....
4½	2½	.205	.211	.217	.224	.232	.240	.....	.....	.....
4½	3	.177	.182	.187	.193	.199	.206	.....	.....	.....
4½	3½	.155	.159	.164	.169	.175	.181	.....	.....	.....
4½	4	.139	.143	.147	.151	.156	.161	.....	.....	.....
4½	4½	.125	.129	.133	.137	.141	.145	.....	.....	.....
4½	9	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	none	.602	.630	.658	.686	.714	.742	.770	.798	.826
9	1½	.250	.258	.266	.275	.284	.293	.303	.313	.324
9	2	.209	.216	.223	.230	.237	.244	.252	.261	.....
9	2½	.179	.185	.191	.197	.203	.210	.217	.....	.....
9	3	.158	.163	.168	.173	.178	.183	.189	.....	.....
9	3½	.142	.146	.150	.154	.158	.163	.168	.....	.....
9	4	.128	.131	.135	.139	.143	.148	.153	.....	.....
9	4½	.116	.119	.122	.126	.130	.134	.....	.....	.....
9	9	.065	.066	.068	.070	.072	.074	.....	.....	.....
13½	none	.426	.444	.463	.481	.500	.518	.537	.555	.574
13½	1½	.214	.221	.228	.235	.243	.251	.259	.267	.275
13½	2	.184	.190	.196	.202	.208	.214	.220	.227	.234
13½	2½	.161	.166	.171	.177	.183	.189	.195	.201	.....
13½	3	.143	.147	.152	.157	.162	.167	.172	.177	.....
13½	3½	.128	.132	.136	.140	.145	.150	.155	.160	.....
13½	4	.117	.120	.124	.128	.132	.136	.140	.....	.....
13½	4½	.109	.112	.115	.118	.121	.125	.129	.....	.....
13½	9	.062	.063	.065	.067	.069	.071	.....	.....	.....
18	none	.330	.343	.356	.369	.383	.396	.410	.424	.438
18	1½	.187	.193	.200	.206	.213	.220	.227	.233	.240
18	2	.164	.169	.175	.180	.186	.191	.197	.203	.209
18	2½	.145	.150	.154	.159	.164	.169	.175	.180	.186
18	3	.131	.135	.139	.143	.148	.152	.157	.161	.166
18	3½	.119	.122	.126	.130	.134	.138	.142	.146	.....
18	4	.110	.113	.116	.119	.123	.126	.130	.134	.....
18	4½	.101	.104	.107	.110	.113	.116	.120	.124	.....
18	9	.060	.061	.063	.064	.066	.068	.....	.....	.....
22½	none	.271	.281	.292	.302	.313	.323	.334	.344	.355
22½	1½	.168	.173	.178	.183	.189	.195	.201	.207	.213
22½	2	.148	.153	.158	.163	.168	.173	.178	.183	.188
22½	2½	.133	.137	.141	.145	.150	.155	.160	.165	.170
22½	3	.120	.124	.128	.132	.136	.140	.144	.148	.153
22½	3½	.110	.113	.117	.120	.124	.128	.131	.135	.140
22½	4	.102	.105	.108	.111	.115	.118	.122	.125	.129
22½	4½	.095	.098	.101	.104	.107	.110	.113	.116	.....
22½	9	.057	.058	.060	.062	.064	.066	.068	.....	.....
		Total losses expressed in B.t.u. per square foot, per hour.								
4½	none	980	1262	1569	1903	2261	2641	3043	3478	3936
4½	1½	276	348	425	506	592	682	775	.....	.....
4½	2	223	281	342	406	475	548	625	.....	.....
4½	2½	189	236	287	341	399	461	.....	.....	.....
4½	3	163	204	247	293	342	396	.....	.....	.....
4½	3½	143	178	217	257	301	348	.....	.....	.....
4½	4	128	160	194	230	268	309	.....	.....	.....
4½	4½	115	145	176	208	243	278	.....	.....	.....
4½	9	....	.....	.....	.....	....	...	.....	.....	.....
9	none	554	706	869	1042	1229	1425	1635	1852	2084
9	1½	230	289	351	418	489	563	642	726	816
9	2	192	242	293	350	408	469	534	606	....
9	2½	165	207	252	299	349	403	460	.....	.....
9	3	145	183	222	263	306	351	400	.....	.....
9	3½	131	164	198	234	272	313	356	.....	.....
9	4	118	147	178	211	246	284	324	.....	.....
9	4½	107	133	161	192	224	257	.....	.....	.....
9	9	60	74	90	106	124	142	.....	.....	.....
13½	none	392	497	611	732	860	995	1139	1288	1447
13½	1½	197	248	301	357	418	482	549	619	684
13½	2	169	213	259	307	358	411	466	526	590
13½	2½	148	186	226	269	315	363	414	466	.....
13½	3	132	165	201	239	279	321	365	411	.....
13½	3½	118	148	180	213	250	288	329	371	.....
13½	4	108	135	164	195	227	261	297	.....	.....
13½	4½	100	126	152	180	208	240	274	.....	.....
13½	9	57	71	86	102	119	136	.....	.....	.....
18	none	304	384	470	561	659	761	869	982	1104
18	1½	172	216	264	313	366	422	481	541	605
18	2	151	189	231	274	320	367	418	471	527
18	2½	133	168	203	242	282	324	371	418	469
18	3	121	151	184	217	255	292	333	374	419
18	3½	110	137	166	198	231	267	301	339	.....
18	4	101	127	153	181	212	242	276	311	.....
18	4½	93	117	141	167	194	223	254	288	.....
18	9	55	68	83	97	113	130	.....	.....	.....
22½	none	250	315	386	459	538	620	708	798	895
22½	1½	155	194	235	278	325	374	426	480	536
22½	2	136	171	209	248	289	332	378	425	473
22½	2½	122	154	186	220	258	298	339	383	428
22½	3	110	139	169	201	234	269	305	343	385
22½	3½	101	127	155	182	213	246	278	313	353
22½	4	94	118	143	169	198	227	259	290	325
22½	4½	87	110	133	158	184	211	240	269	.....
22½	9	52	65	79	94	110	127	144	.....	....

Metal Surfaces

Insulation Specification, using Superex Combination where required	†Average operating temp., deg. F.	Bare surface loss, b.t.u. per sq. ft. per hr.	85% Magnesia: Heat transmission, b.t.u. per sq. ft. per hr.	85% Magnesia: Insulation efficiency, per cent	Asbesto-Sponge Felted: Heat transmission, b.t.u per sq. ft. per hr.	Asbesto-Sponge Felted: Insulation efficiency, per cent
	150	215	19.6	90.89	17.2	92.01
	200	360	29.7	91.75	26.4	92.66
	250	533	40.1	92.48	36.2	93.20
	300*	737	50.7	93.13	46.4	93.71
	150	215	16.2	92.47	14.2	93.40
	200	360	24.6	93.16	21.8	93.94
	250	533	33.2	93.76	29.8	94.41
	300	737	42.0	94.31	38.3	94.81
	350	978	51.1	94.77	47.0	95.19
	400*	1269	60.5	95.23	56.2	95.57
	200	360	20.9	94.19	18.5	94.86
	250	533	28.2	94.71	25.3	95.25
	300	737	35.8	95.15	32.6	95.58
	350	978	43.6	95.54	40.1	95.90
	400	1269	51.7	95.92	48.0	96.22
	450	1614	59.9	96.29	55.9	96.54
	500*	2007	68.2	96.60	64.6	96.78
	250	533	24.6	95.38	21.9	95.89
	300	737	31.2	95.77	28.3	96.16
	350	978	38.0	96.11	34.7	96.45
	400	1269	45.0	96.45	41.4	96.72
	450	1614	52.1	96.77	48.6	96.99
	500	2007	59.5	97.03	56.4	97.19
	550	2460	67.0	97.28	63.8	97.41
	600*	2959	74.6	97.47	71.6	97.58
	250	533	22.8	95.72	20.9	96.08
	350	978	35.0	96.42	32.4	96.69
	450	1614	47.7	97.04	44.8	97.23
	500	2007	54.3	97.29	51.3	97.45
	550	2460	61.0	97.52	58.0	97.64
	600	2959	68.0	97.70	64.9	97.81
	650	3510	75.0	97.86	72.1	97.94
	700	4111	82.4	98.00	79.7	98.06
	750*	4760	89.8	98.11	87.4	98.17
	300	737	29.2	96.04	27.2	96.31
	400	1269	41.8	96.70	39.2	96.91
	500	2007	54.9	97.27	52.0	97.41
	600	2959	68.7	97.67	65.6	97.78
	700	4111	83.0	97.98	80.0	98.05
	800	5456	98.1	98.20	95.5	98.25
	850	6200	106.1	98.29	103.2	98.33
	900*	6991	114.2	98.37	111.5	98.40
	500	2007	49.7	97.52	47.2	97.65
	600	2959	62.2	97.90	59.4	97.99
	700	4111	75.1	98.17	72.5	98.24
	750	4760	82.0	98.28	79.3	98.34
	800	5456	88.9	98.37	86.1	98.42
	850	6200	96.0	98.45	93.4	98.49
	900	6991	103.2	98.52	100.8	98.56
	950	7830	110.6	98.59	108.5	98.61
	1000*	8716	118.1	98.64	116.2	98.67
	600	2959	57.2	98.07	55.1	98.14
	700	4111	69.1	98.32	67.0	98.37
	800	5456	81.7	98.50	79.6	98.54
	900	6991	94.7	98.64	92.7	98.67
	1000	8716	108.3	98.75	106.7	98.78
	1050	9650	115.6	98.80	114.0	98.82
	1100	10631	122.9	98.84	121.3	98.86
	1150	11660	130.4	98.88	129.2	98.89
	1200*	12736	138.0	98.91	137.2	98.92

¶ Losses shown are for still air conditions. Air temperature, 80 deg. F. † The computations are made for still air at 50 deg. F. Temperature difference, surface to air, is therefore equal to 50 deg. F. less than the average operating temperatures shown. * Maximum recommended temperature for use with the materials in the thicknesses shown at the left.

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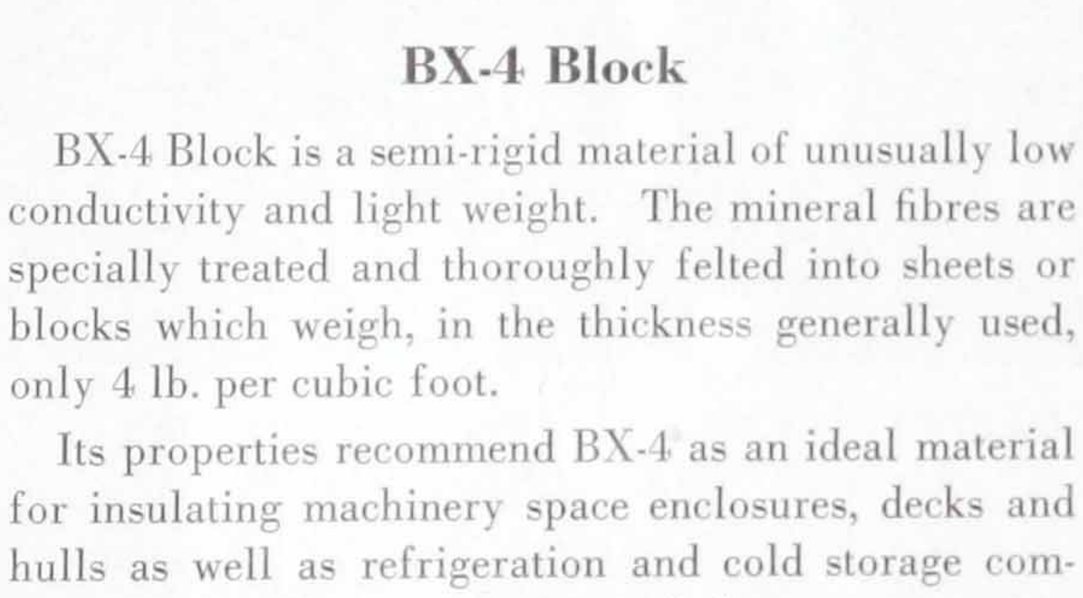
Johns-Manville BX Blocks

J-M BX Blocks, insulations developed especially for marine service, are made of a waterproofed, blended mineral felt. These materials combine with exceptional insulating efficiency the characteristics of light weight, non-combustibility and practical immunity to moisture and mold. Thus BX Blocks afford a most practical means to insulate adequately, without excessive weight, both passenger and cargo craft. Moreover, the facility of handling the insulations, makes for low installation cost. Faced with perforated metal or Marine Veneer, BX Blocks may be used as a deckhead material which in addition to thermal insulation provides acoustical treatment as well. Two types of BX Blocks are available: BX-4 Block and BX-18 Block.



Samples of BX-4 cut from large sheets

Installing BX-18 Block over steel plating

BX-4 Block

BX-4 Block is a semi-rigid material of unusually low conductivity and light weight. The mineral fibres are specially treated and thoroughly felted into sheets or blocks which weigh, in the thickness generally used, only 4 lb. per cubic foot.

Its properties recommend BX-4 as an ideal material for insulating machinery space enclosures, decks and hulls as well as refrigeration and cold storage compartments. These properties include:

Light Weight: For 3/8″ to 3/4″ thicknesses—7 lb. per cu. ft. For 1″ to 3″ thicknesses—4 lb. per cu. ft. When plied in greater thicknesses to 12″—2.75 lb. per cu. ft. Weights may vary plus or minus 10 percent.

Low Conductivity: Approximately 0.24 B.t.u. per sq. ft. per hour, per deg. F. temperature difference, per inch of thickness, at 95 deg. F. mean temperature.

Fire Resistance: Completely fire resisting. When a red hot rivet is placed in it, the block does not smolder over an area greater than 1″ beyond the rivet.

Moisture Resistance: When exposed to 95 percent relative humidity at 95 deg. F. for 120 days, BX-4 Block shows no gain in weight.

Facility in Handling: The extremely fine fibres give the material a resiliency which permits handling in transit and application without loss of effective thickness. In this respect BX-4 compares favorably with animal fibres, such as hair; it is superior to other synthetic fibres. The material is sufficiently rigid to be handled in one piece for fitting between stiffeners.

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BX Block under sheathing of this boiler-room casing makes adjoining quarters comfortable

Standard Sizes, Thicknesses and Weights:

Standard sizes of BX-4 Blocks are any even fraction of 60″ x 120″ for thicknesses of 2″ and over; for lesser thicknesses, except on special order, 60″ x 60″ or even fractions. To reduce erection costs, exact sizes to fit beam or frame spacings may be ordered.

The following standard thicknesses are available:

Thickness, inches	Average weight, oz. per sq. ft.
⅜	3.50
½	5.25
¾	7.00
1	5.33
1½	8.00
2	10.67
2½	13.34
3	16.00

For refrigeration space insulation BX-4 is furnished plied up to single thicknesses of 12″ or less, weighing approximately 2.75 lb. per cu. ft.

BX-4 Felt, the same material, but weighing as little as 2.5 lb. per cu. ft., is available in resilient strips for spirally wrapping pipes, and in widths up to 60″ with sewed facings of asbestos paper, waterproof paper or flame-proofed muslin for other special purposes.

BX-18 Block

BX-18 Block is a rigid, fireproof insulating materia formed from rock wool and a suitable waterproofin binder. This material possesses a low thermal con ductivity, ample strength for handling and high re sistance to moisture.

BX-18 has been used in considerable quantities t insulate shells, decks and machinery space casings. I is particularly suitable for floor insulation in refriger ation spaces and for ceilings.

Used as an insulating ceiling, BX-18 can be shel lacked and painted for a stippled effect; covered with perforated metal or Marine Veneer, it is an efficient sound-quieting material.

This material, like BX-4, is fireproof and, because it will not support combustion, it may be used where combustible or merely "fire-retarding" materials would present a fire hazard.

The weight of BX-18 is approximately 1½ lb. per board foot, 18 lb. per cubic foot. It has a modulus of rupture of approximately 70 lb. per sq. in., far stronger than is required in service.

Standard Sizes, Thicknesses and Weights:

BX-18 Block is supplied in one standard size, 24″ x 36″ in three thicknesses:

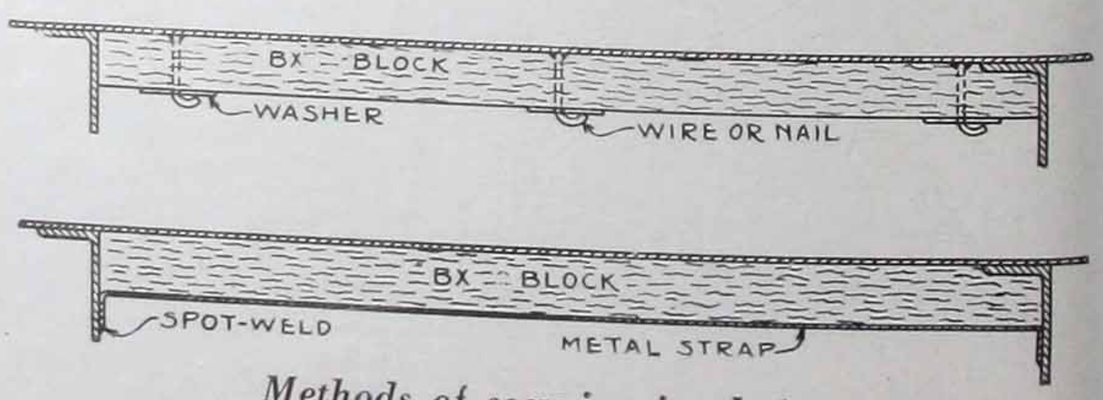
½″	0.75 lb. per sq. ft.
1″	1.50 lb. per sq. ft.
1½″	2.25 lb. per sq. ft.

Methods of Installation

BX Blocks may be secured in place with an adhesive or by mechanical means, depending upon the location and service.

BX-4 may be installed against ships' sides with BX Cement. On overhead or side work the BX-4 may be impaled over welding wires or wire nails which have been spot-welded to the steel and secured with washers under the bent ends of the wire.

BX-18 may be secured by the use of wires or nails and washers as described above or by 1/16″ x 1½″ galvanized steel straps across the insulation.



Methods of securing insulation

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Banroc Blankets

For temperatures to 1000 deg. F.

Banroc Blanket Insulation is a flexible insu-ating material composed of special annealed anroc, a long fibre, white rock wool, felted and ecured between metal fabrics of various types. he density and thickness of bat used are carefully ontrolled so that the blankets will not run under size hen subjected to compression in shipping or han-ling, thereby insuring full insulation value. All dges are smooth, full and square. Up to 1000 deg. ., they can be used for the insulation of ovens, oil efinery equipment and for similar purposes.

Depending upon the use to which the blankets are to e put, in manufacture the felted Banroc is secured ith galvanized tie wires between metal fabrics of arious types or secured with asbestos twine between lies of asbestos paper. The metal fabrics used are o. 12 mesh fly screen wire, 1″ galvanized wire net-ing, heavy copper bearing metal lath, ⅜″ rib lath, and ¼″ rib lath. To resist rusting, a special type copper earing lath is used exclusively.

Standard types of Banroc Blankets

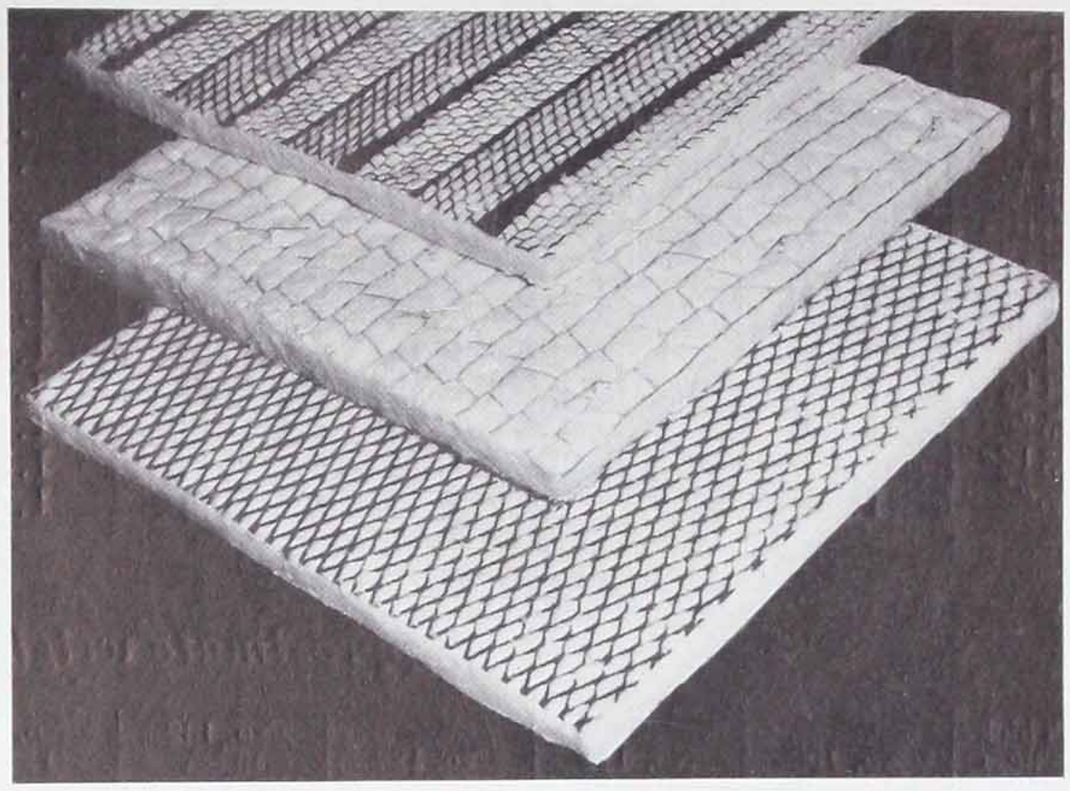
Style No.	Type of Metal Fabric
102	1″ wire mesh on both sides
112	1″ wire mesh and metal lath
122	Metal lath on both sides
132	1″ wire mesh and ⅜″ rib lath
132-A*	Same as No. 132 except rib turned out
142	Metal lath and ⅜″ rib lath
142-A*	Same as No. 142 except rib turned out
152	1″ wire mesh and ¾″ rib lath
152-A*	Same as No. 152 except rib turned out
162	Metal lath and ¾″ rib lath
162-A*	Same as No. 162 except rib turned out
172**	⅜″ rib lath on both sides
182	Asbestos paper on both sides
192	No. 12 mesh-fly screen wire on both sides

*On this type of blanket, the turned out rib provides an air space, where such an air space is desired.

**Ribs may be turned in or out, and run lengthwise or across the blanket, or at right angles to each other, as specified.

Sizes:

With the exceptions noted later, Banroc Blankets are furnished in standard sizes, 24″ x 96″ and 24″ x 48″, and in thicknesses of 1, 1¼, 1½, 1¾, 2, 2½, 3, 3½, 4, 4½, 5, 5½ and 6 inches. Style No. 182 is made 24″ x 48″ in thicknesses up to and including 3½″; and 4″ thickness in 24″ x 24″ only. Style No. 192 is furnished 24″ x 96″ and 24″ x 48″ in thicknesses of 1″, 1¼″, 1½″, 1¾″ and 2″. Banroc Blankets can also be manufactured in other sizes on special order. All blankets are shipped crated.



Various Banroc Blankets, showing metal fabrics used. Top, rib lath; center, wire mesh; bottom, expanded metal lath

No. 102-R Banroc Blanket is specially manufactured for certain classes of tank insulation. It is the same as No. 102 except for the addition of J-M Medium Pilot Roofing under the mesh on one side. List prices do not apply on this blanket.

A metal-jacketed Banroc Blanket can be furnished on order. This consists of Style No. 112 Blanket with No. 18 or No. 20-gauge rust-resisting sheet iron secured over the wire mesh by means of special shoulder rivets, extending through the blanket and fastened under washers on the metal lath side. Blueprints are required for quotation.

Where desired, other than the standard styles of blankets can be furnished, or other than special annealed wool used. The various types of Banroc Wool are described in another data sheet.

The density of the pads in the standard types of blankets above equals 1 lb. per sq. ft., 1″ thick, with a tolerance of plus 15 percent and minus 10 percent.

No. 202 Banroc Blanket cannot be classified with the other types. It is a blanket of the standard wool, 12″ to 60″ wide, backed one or both sides with Kraft or Armaturo paper, sewed in place. The regular width is 36″ and standard lengths range from a minimum of 8 ft. to a maximum, ½″ thick, of 65 ft.; 1″ thick, 35 ft.; 1½″ thick, 26 ft.; and 2″ thick, 18 ft. This is an improved material for manufacturers to use in insulating automatic water heaters, underneath the outside casing. Density of No. 202 blankets is 1 to 1.25 lb. per sq. ft., 1″ thick.

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List prices per square foot, crated

Thick-ness	No. 102	No. 112	No. 122	Nos.132 132-A	Nos.142 142-A	Nos. 152 152-A	Nos. 162 162-A	No. 172	No. 182	No. 19
1″	$ .40	$ .45	$ .55	$ .60	$ .60	$ .70	$ .75	$ .75	$ .65	$ .60
1¼″	.45	.53	.60	.65	.65	.75	.83	.83	.70	.65
1½″	.50	.60	.65	.70	.70	.80	.90	.90	.75	.70
1¾″	.55	.65	.70	.75	.75	.85	.95	.95	.80	.75
2″	.60	.70	.75	.80	.80	.90	1.00	1.00	.85	.80
2½″	.70	.80	.85	.90	.90	1.00	1.10	1.10	.95	....
3″	.80	.90	.95	1.00	1.00	1.10	1.20	1.20	1.05	....
3½″	.88	.98	1.03	1.08	1.08	1.18	1.28	1.28	1.13	....
4″	.95	1.05	1.10	1.15	1.15	1.25	1.35	1.35	1.20	....
4½″	1.03	1.13	1.18	1.23	1.23	1.35	1.45	1.45	....	....
5″	1.10	1.20	1.25	1.30	1.30	1.45	1.55	1.55	....	....
5½″	1.18	1.28	1.33	1.38	1.38	1.55	1.65	1.65	....	....
6″	1.25	1.35	1.40	1.45	1.45	1.65	1.75	1.75	....	....

Approximate weight, lb. per sq. ft., crated

Thick-ness	No. 102	No. 112	No. 122	No. 132 132-A	No. 142 142-A	No. 152 152-A	No. 162 162-A	No. 172	No. 182	No. 192
1″	1.42	1.62	1.82	1.66	1.86	1.95	2.15	1.90	1.42	1.42
1¼″	1.73	1.93	2.13	1.97	2.17	2.26	2.46	2.21	1.73	1.74
1½″	2.03	2.23	2.43	2.27	2.47	2.56	2.76	2.51	2.02	2.03
1¾″	2.35	2.55	2.75	2.59	2.79	2.88	3.07	2.83	2.34	2.35
2″	2.64	2.84	3.04	2.88	3.08	3.17	3.37	3.12	2.63	2.65
2½″	3.19	3.39	3.60	3.43	3.63	3.72	3.92	3.67	3.19	....
3″	3.86	4.06	4.26	4.10	4.30	4.39	4.59	4.34	3.85	....
3½″	4.49	4.69	4.89	4.73	4.93	5.02	5.22	4.97	4.48	....
4″	4.99	5.19	5.39	5.23	5.43	5.52	5.72	5.47	4.98	....
4½″	5.69	5.89	6.09	5.93	6.13	6.22	6.42	6.17	....	....
5″	6.19	6.39	6.59	6.43	6.63	6.72	6.92	6.67	....	....
5½″	7.01	7.21	7.41	7.25	7.45	7.54	7.74	7.49	....	....
6″	7.51	7.71	7.91	7.75	7.95	8.04	8.24	7.99	....	....

Actual shipping weights may vary plus or minus 10 percent.
For export, add 0.13 lb. per square foot board measure to above weights.

Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot, per degree temperature difference, per hour.
Efficiency expressed in per cent of bare surface loss.

Insulation thickness, including ½″ cement finish		Temperature of Surface, deg. F. 175	225	275	325	375	475	575	675	775	875	975
		Temperature Difference between Surface and Air, deg. F. 100	150	200	250	300	400	500	600	700	800	900
1½″	Heat loss, B.t.u.	.286	.294	.302	.310	.318	.334	.351	.369	.386	.406	.431
	Efficiency, %	86.71	87.75	88.67	89.50	90.25	91.73	92.87	93.70	94.30	94.55	95.10
2″	Heat loss, B.t.u.	.207	.213	.220	.226	.233	.246	.260	.275	.288	.304	.322
	Efficiency, %	90.38	91.13	91.74	92.34	92.86	93.91	94.72	95.30	95.80	95.90	96.30
2½″	Heat loss, B.t.u.	.163	.168	.174	.179	.185	.196	.207	.219	.230	.249	.259
	Efficiency, %	92.42	93.00	93.47	93.93	94.33	95.14	95.79	96.26	96.61	96.79	97.00
3″	Heat loss, B.t.u.	.135	.139	.144	.148	.153	.162	.172	.182	.192	.203	.216
	Efficiency, %	93.73	94.21	94.60	94.98	95.31	95.98	96.51	96.89	97.17	97.38	97.50
3½″	Heat loss, B.t.u.	.114	.118	.122	.126	.130	.138	.147	.156	.164	.174	.186
	Efficiency, %	94.71	95.08	95.43	95.73	96.02	96.58	97.01	97.33	97.55	97.70	97.90
4½″	Heat loss, B.t.u.	.088	.091	.094	.097	.100	.106	.113	.121	.129	.138	.147
	Efficiency, %	95.87	96.21	96.47	96.71	96.93	97.38	97.70	97.93	98.11	98.22	98.32
5½″	Heat loss, B.t.u.	.072	.074	.077	.079	.082	.087	.092	.098	.105	.112	.119
	Efficiency, %	96.66	96.92	97.11	97.32	97.48	97.84	98.13	98.26	98.48	98.56	98.63
6½″	Heat loss, B.t.u.	.060	.062	.065	.067	.069	.073	.078	.083	.089	.095	.102
	Efficiency, %	97.10	97.30	97.60	97.75	97.89	98.19	98.43	98.58	98.69	98.77	98.83

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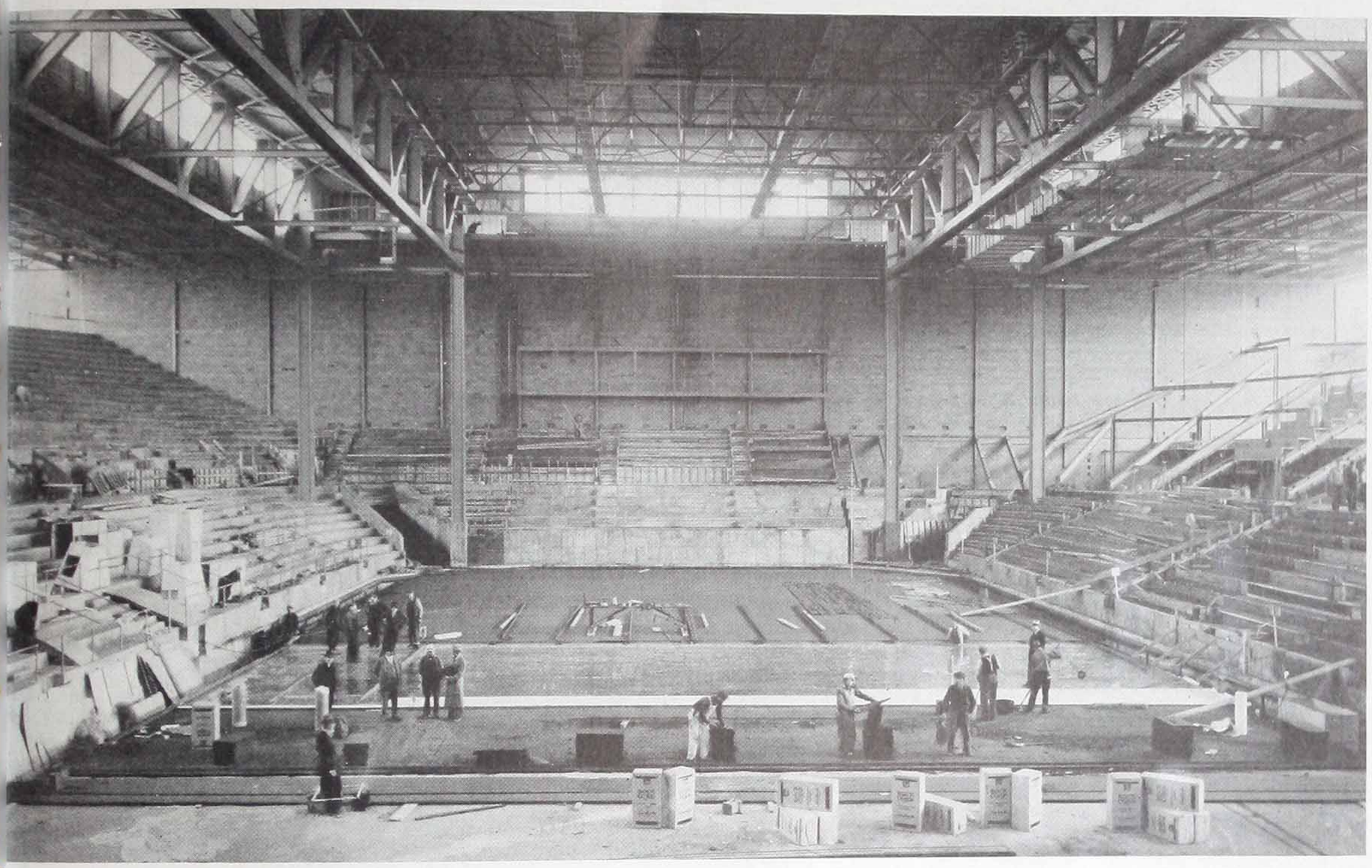
J-M Rock Cork



A double layer of 2" Rock Cork sheets being laid for the skating rink in the Cleveland Arena, Cleveland, Ohio. In addition to resisting the strains set up by massed formations in hockey, this floor is capable of holding the dead weight of heavy exhibits

J-M Rock Cork is a low-temperature insulating material manufactured from Banroc, a loose rock wool, combined in production with a waterproof binder, moulded into sheet form and baked. Its recommended range of use covers all refrigeration applications and other low temperature work. For duct insulation, when Fibrous Adhesive is used instead of asphalt and when the Rock Cork is securely fastened, the Rock Cork may be used at temperatures as high as 150 deg. F.

Rock Cork has been used since 1908 with exceptional success as an insulating material for all kinds of cold storage construction. The qualities responsible for its continued wide use include:

1. Ability to retain low conductivity at low service temperatures.
2. Non-absorption of moisture and odor.
3. Possibility of thorough sealing against penetration of air.
4. Immunity to termites, vermin and mold.
5. Structural strength to permit handling and applying without breakage.
6. Ease of sawing and working on the job.

Characteristics of Rock Cork

The conductivity of J-M Rock Cork is 0.33 B.t.u. per sq. ft., per deg. F. temperature difference, per inch thick, per hour. Due to the natural interlacing of the fibres, a large number of minute dead-air cells are formed, which are responsible for the high insulating value.

The resistance to moisture, which is a marked characteristic of Rock Cork, is an important factor in maintaining its original low conductivity in service. Examination of a number of installations with an average of 17 years in use showed a moisture pick-up of 1.1 percent average, with no instance of more than 2 percent. This low moisture absorption adds to the longevity of the construction and thus increases the economy effected by the use of Rock Cork.

Due to the nature of its waterproof binder, Rock Cork furnishes an ideal base for an asphaltic adhesive or finish, assuring an air-tight, waterproof seal.

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Hot-mopping Rock Cork sheets over a concrete floor

The binding material with which Banroc is combined, in the manufacture of J-M Rock Cork, gives the material a firm structure which permits ready handling and installing in any type of construction. It has, however, sufficient compressibility to follow slight irregularities of the surface to be insulated, eliminating voids between the insulation and the wall.

All materials used in the manufacture of Rock Cork are odorless, and the most sensitive food products will not absorb offensive odors from this material. Due to its mineral composition, it will not harbor rats, insects or vermin of any kind. Extensive tests have demonstrated that Rock Cork will not, under any conditions, support the growth of bacteria or mold.

The fibrous nature of Rock Cork permits absolutely tight joints, not possible with the granular edges of other material.

Sizes and Types of Rock Cork

J-M Rock Cork sheets are furnished in the following standard sizes and thicknesses: 18″ x 36″, in thicknesses of 1½″, 2″, 3″ and 4″, and 18″ x 18″ in 1″ thickness. Other sizes, within the above limitations, and intermediate thicknesses can be furnished on special order.

The sheets weigh 1.25 to 1.33 lb. per sq. ft. pe inch of thickness, uncartoned. Cartoned, the weight are 1.4 to 1.5 lb. per sq. ft. per inch of thickness

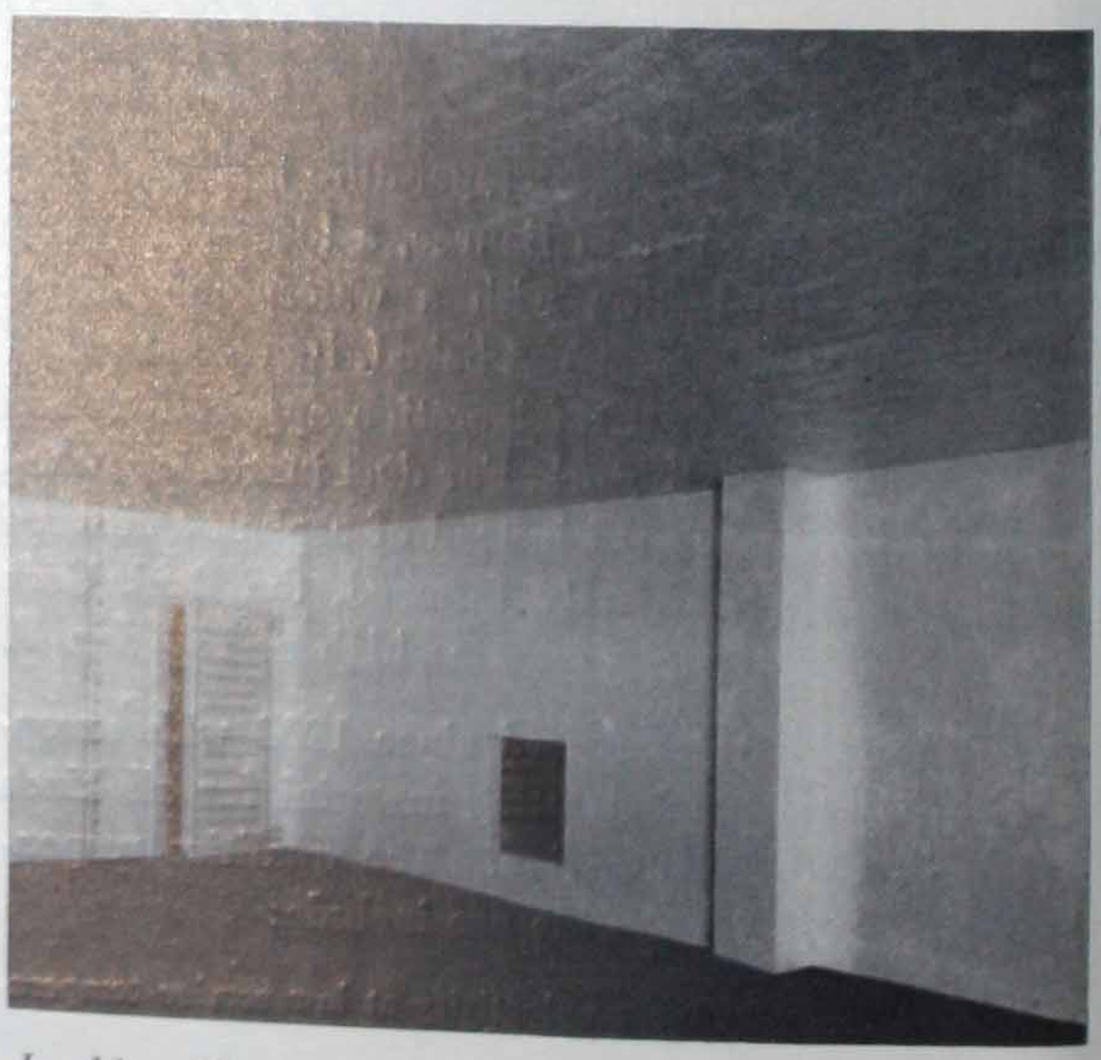
Rock Cork in lagging form for curved surfaces suc as columns is made to accommodate diameters fror 18″ to 20 ft., and is supplied 18″ long, in thicknesse of 1½″, 2″, 3″ and 4″, and from 2″ to 5″ wide, de pending on the diameter.

Flat discs are furnished in 1½″, 2″, 3″ and 4′ thicknesses in one piece up to 18″ diameter; and i two pieces for larger diameters up to 36″.

Rock Cork is also manufactured in granular form for use where an insulation which can be poured into place is desired. Granulated Rock Cork should be packed to a density of 12 to 14 lb. per cu. ft. Furnished in 35-lb. paper bags and in burlap bags of random weights.

Where hand packing, rather than pouring, is required to fill irregular spaces, Zerofil is recommended. This is an asphalt-treated loose rock wool which is especially convenient for packing around ice-making tanks, etc. Zerofil should be packed to a density of approximately 10 lb. per cu. ft. Shipped in 35-lb. paper bags and in random-weight burlap bags.

Rock Cork Pipe Insulation is described on other data sheets.



In this milk room the solid Rock Cork partitions at the right were built of two layers of sheets with a ½″ core of portland cement mortar, the first layer being erected over temporary studding. The finish used was portland cement plaster. For better waterproofing, a smoothly troweled ¼″ coat of Insulkote is recommended

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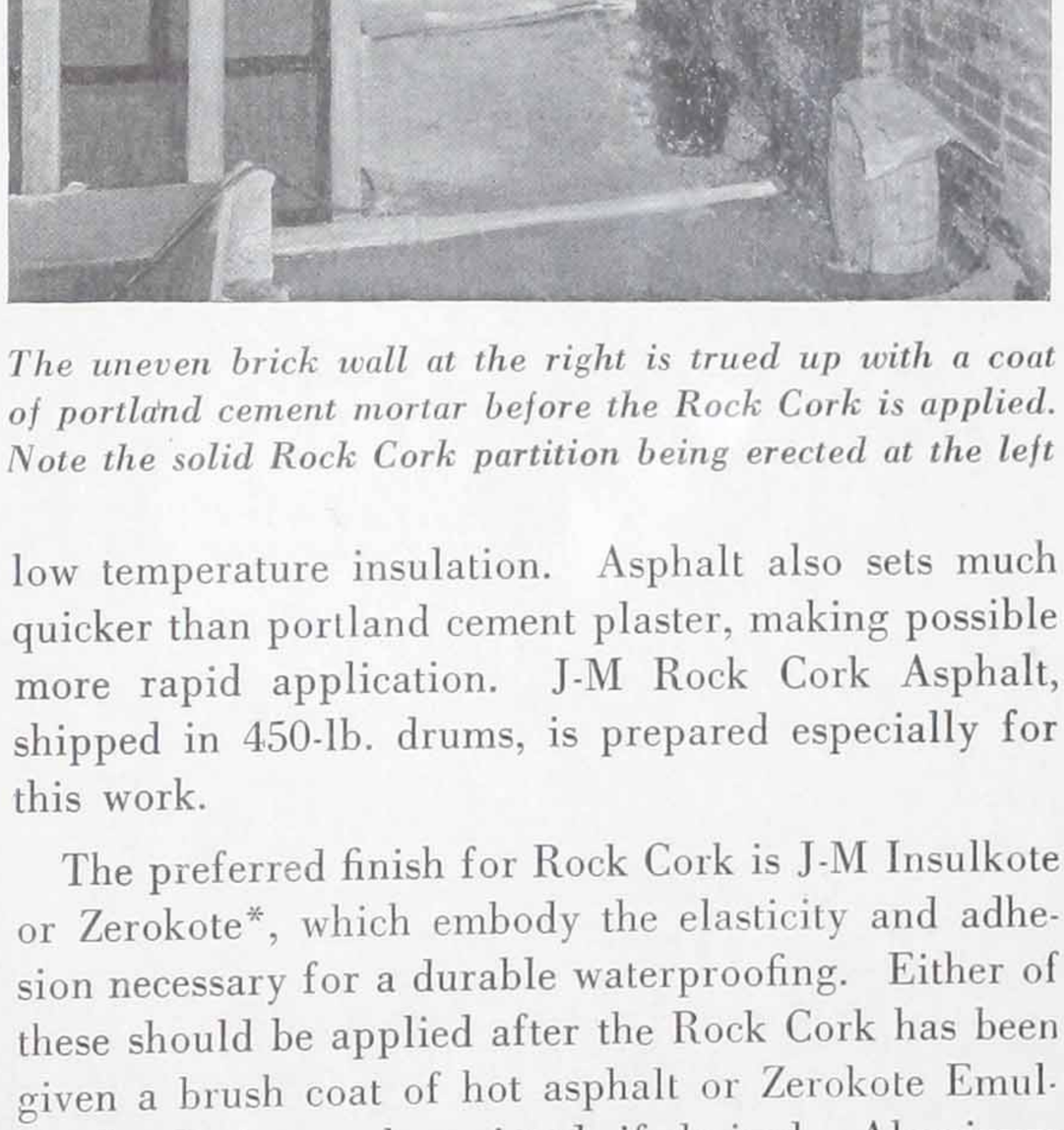
Uses for J-M Rock Cork

J-M Rock Cork in sheet and lagging form is used s a standard cold insulation for any form of cold orage construction or refrigerating equipment. Rock ork has a record of successful service in meat eezers and coolers, quick freeze rooms and equip- ient, ice cream hardening rooms, ice storage rooms nd ice manufacturing tanks, fruit and vegetable orages, air conditioning equipment, rooms and equip- ient for the dewaxing of lubricating oils, brine oolers, indoor and outdoor cold tanks including much pecialized equipment such as gas purifier boxes. areful inspection of jobs insulated with J-M Rock ork as far back as 1908, show the material to be in erfect condition after these many years of service.

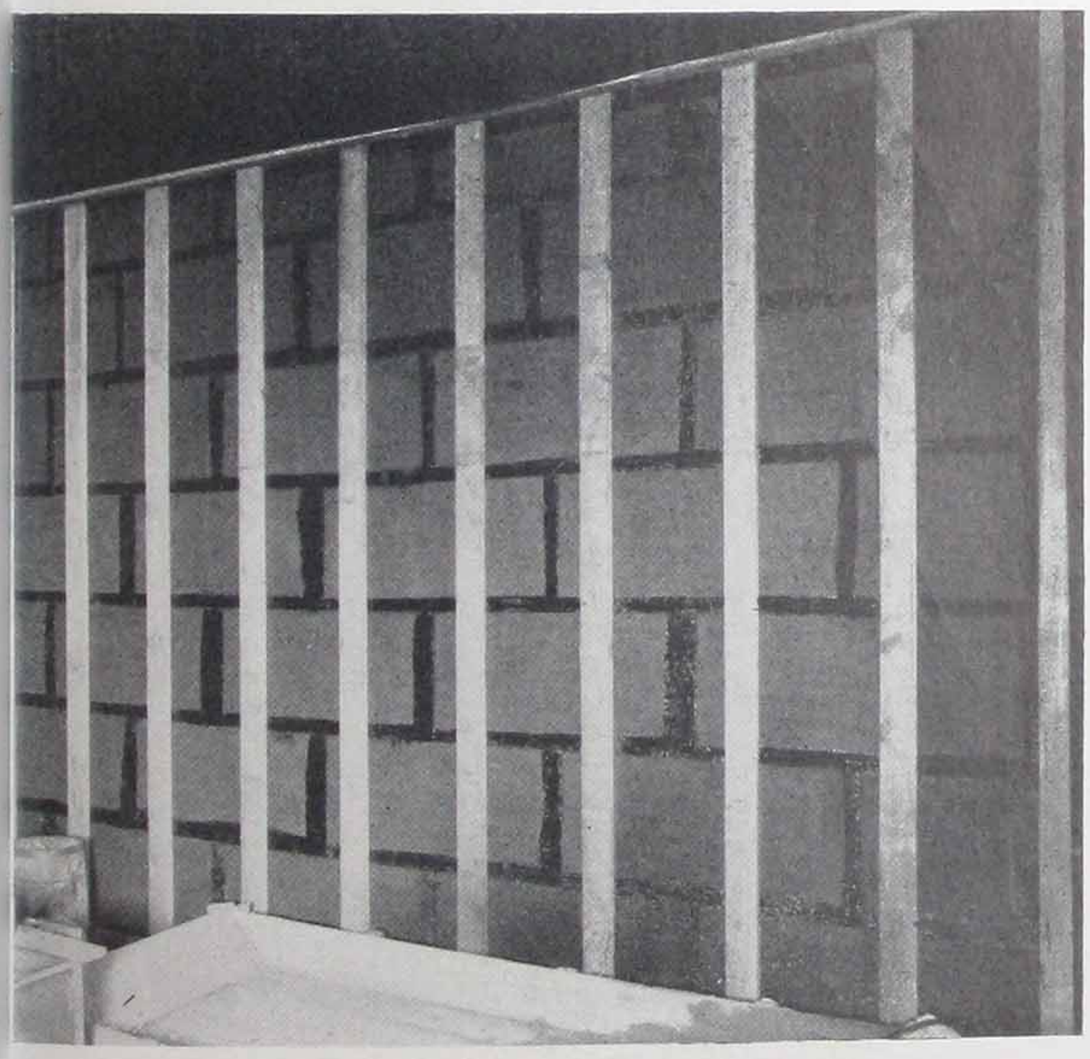
Applying J-M Rock Cork

The application of low-temperature insulation of ny type involves more care than is common with in- ulation against heated surfaces. With low tempera- ures, the insulation must not only be permanently vaterproofed but must also be sealed against the in- iltration of moist air which in time would condense nd destroy any insulation. While portland cement nay be used for adhesion of Rock Cork, asphalt has he distinct advantage of providing waterproof con- truction, a most important feature in applying any low temperature insulation. Asphalt also sets much quicker than portland cement plaster, making possible more rapid application. J-M Rock Cork Asphalt, shipped in 450-lb. drums, is prepared especially for this work.



The uneven brick wall at the right is trued up with a coat of portland cement mortar before the Rock Cork is applied. Note the solid Rock Cork partition being erected at the left

The preferred finish for Rock Cork is J-M Insulkote or Zerokote*, which embody the elasticity and adhesion necessary for a durable waterproofing. Either of these should be applied after the Rock Cork has been given a brush coat of hot asphalt or Zerokote Emulsion*. Both may be painted, if desired. Aluminum paint can be applied directly; any other type of paint requires a prime coat of shellac or varnish. Portland cement plaster may also be used as a finish over Rock Cork but is not recommended due to the comparative ease with which water penetrates it.



Rock Cork sheets make ideal partitions where it is desired to divide refrigerated rooms. The temporary studs are removed after erection and a finish of portland cement plaster is applied

*Zerokote is a job-mixed finish consisting of 35 percent (or lb.) Zerokote Emulsion, 45 percent (or lb.) plaster's sand, 20 percent (or lb.) of J-M No. 302 Cement and about 4 gal. (33 lb.) of water. The sand and cement are mixed dry and then mixed with the Zerokote Emulsion to which 2½ gal. of water has been added. More of the water is added slowly until a good troweling consistency is obtained. Too much water should be avoided.

Zerokote should not be used when the temperature is likely to exceed 100 deg. F. nor for a finish on insulation exposed to direct action of the weather. Zerokote Emulsion is furnished in 5, 30 and 55-gal. containers.

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J-M Rock Cork is applied in accordance with the specifications which have been developed and found sound during many years of experience with this material on all kinds of refrigeration work. The application of Rock Cork by J-M Insulation Service Units is made in accordance with these specifications.

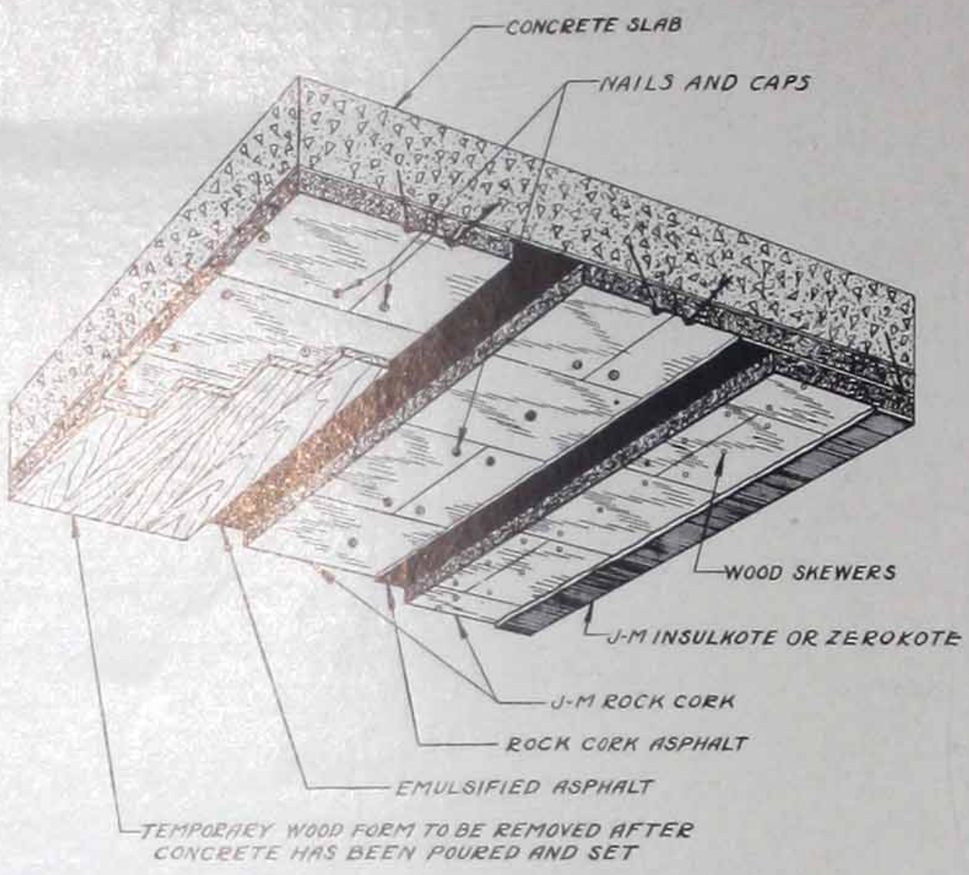
Thicknesses Recommended

While many factors, such as the cost of refrigeration, and local atmospheric and temperature conditions, may govern the amount of insulation which should be used, the thicknesses of sheets or lagging given in the following table are recommended for general requirements:

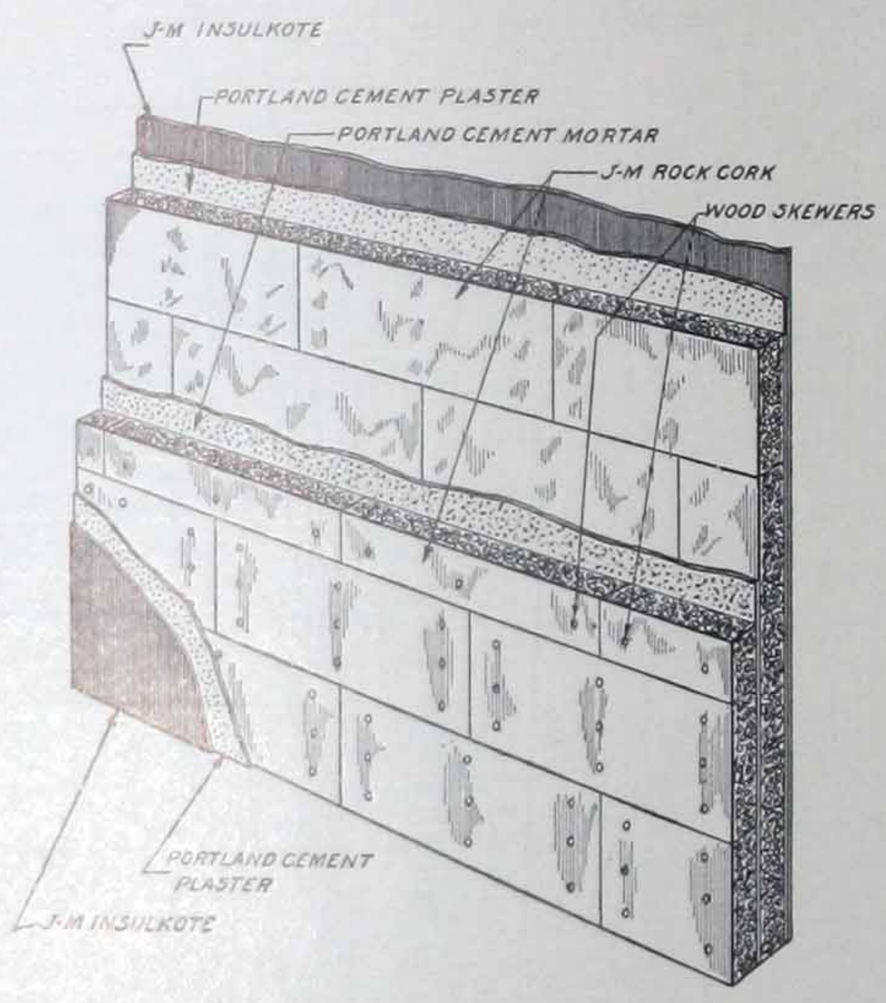
Temperature range, deg. F.	Thickness
−60 to −40	12″—Three layers
−40 to −25	10″—Three layers
−25 to −15	8″—Two layers
−15 to 0	7″—Two layers
0 to 15	6″—Two layers
15 to 25	5″—Two layers
25 to 35	4″—One or two layers
35 to 45*	3″ or 2″—Single layer

* Suitable thickness of insulation at this higher temperature range generally depends on other factors more than temperature difference. Among these are cost of refrigeration, surface temperature and dew point.

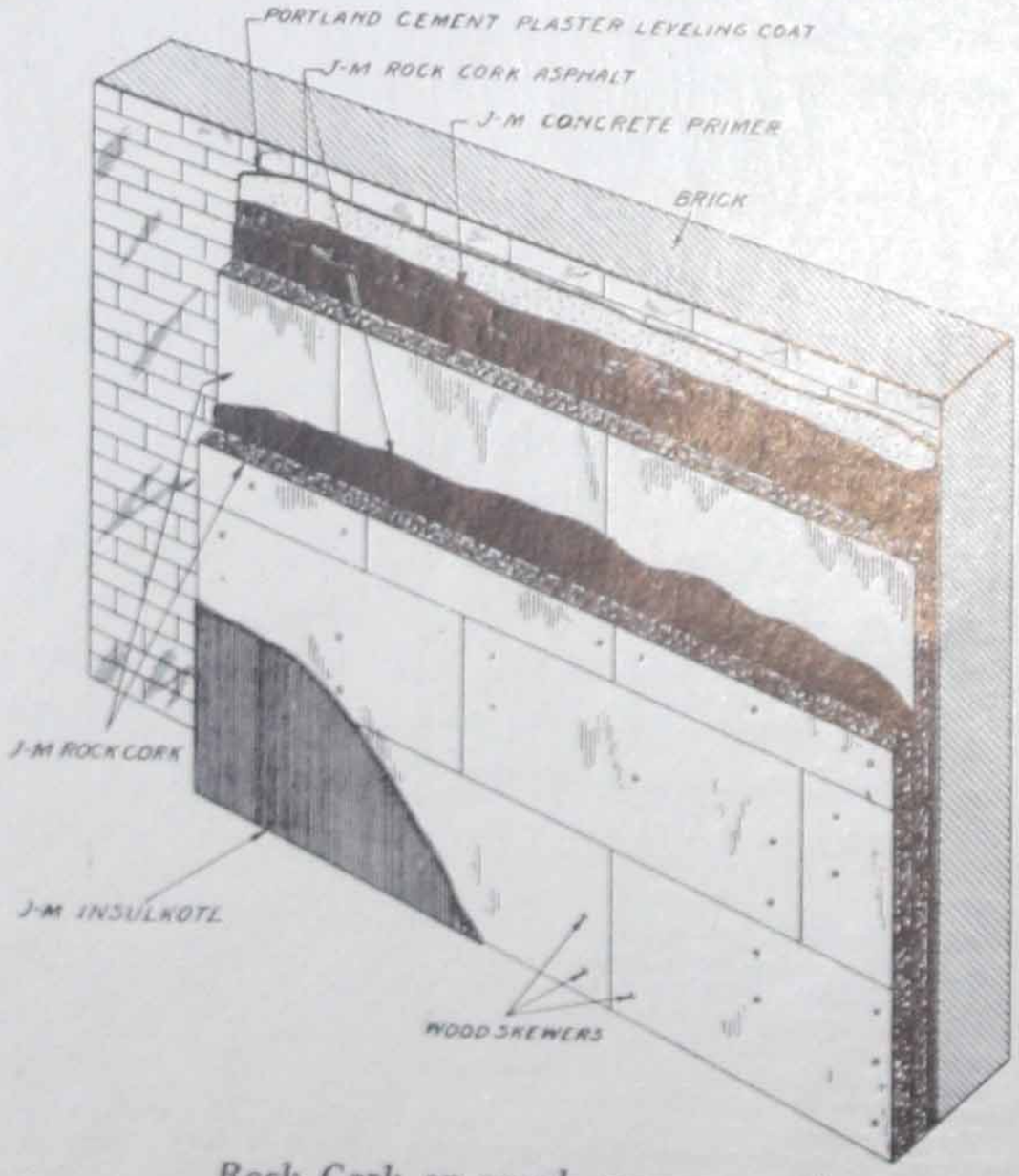
In the use of low-temperature insulation in loose or granular form, it is customary to employ twice the thickness recommended for sheets or lagging.



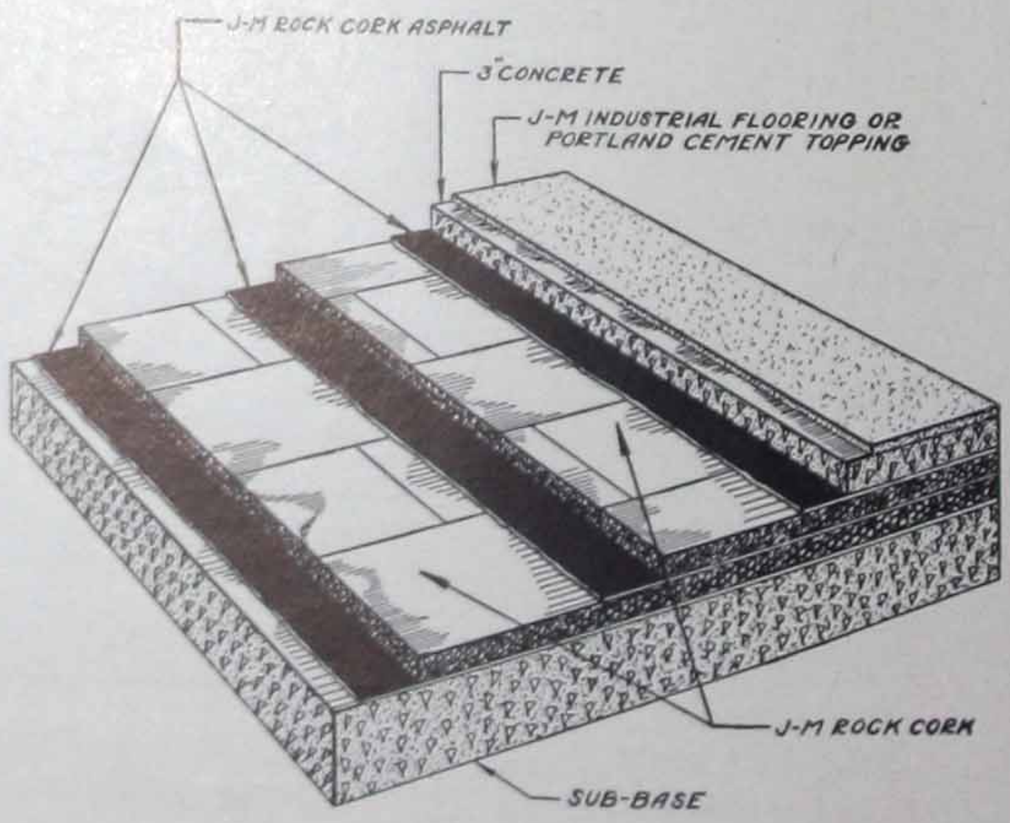
Rock Cork construction for ceiling insulation



Solid Rock Cork partition



Rock Cork on rough masonry wall



Rock Cork floor insulation

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J-M Asbestos Sheet Millboard

J-M Asbestos Sheet Millboard is recommended for eneral uses requiring sheet or board for protection gainst fire, heat, acid fumes, etc. It is frequently sed as a fireproof lining for floors, partitions, ceilngs, elevator shafts, ranges, stoves, grates, etc. It also as many industrial uses.

Millboard can be cut with shears to any size desired nd fastened with nails or screws.

The size of the standard sheet is 42″ x 48″, ut the material is also furnished in cut pieces. hipped in crates containing approximately 350 lb.

lo. 106 Millboard:

This grade is most commonly used because it is ow in price and will take care of the majority of onditions where Millboard is required. It will withand temperatures up to about 800 deg. F., but is not enerally recommended for use at temperatures above 00 deg. F. Thicknesses 1/32″ to 3/4″.

lo. 105 Millboard:

This grade is slightly higher quality than No. 106 Millboard, since it contains longer fibre and is herefore somewhat stronger and more resilient. It ill also withstand higher temperatures and may be sed for temperatures up to about 900 deg. F. hicknesses 1/32″ to 1/2″.

lo. 101, No. 102 and No. 103 Millboard:

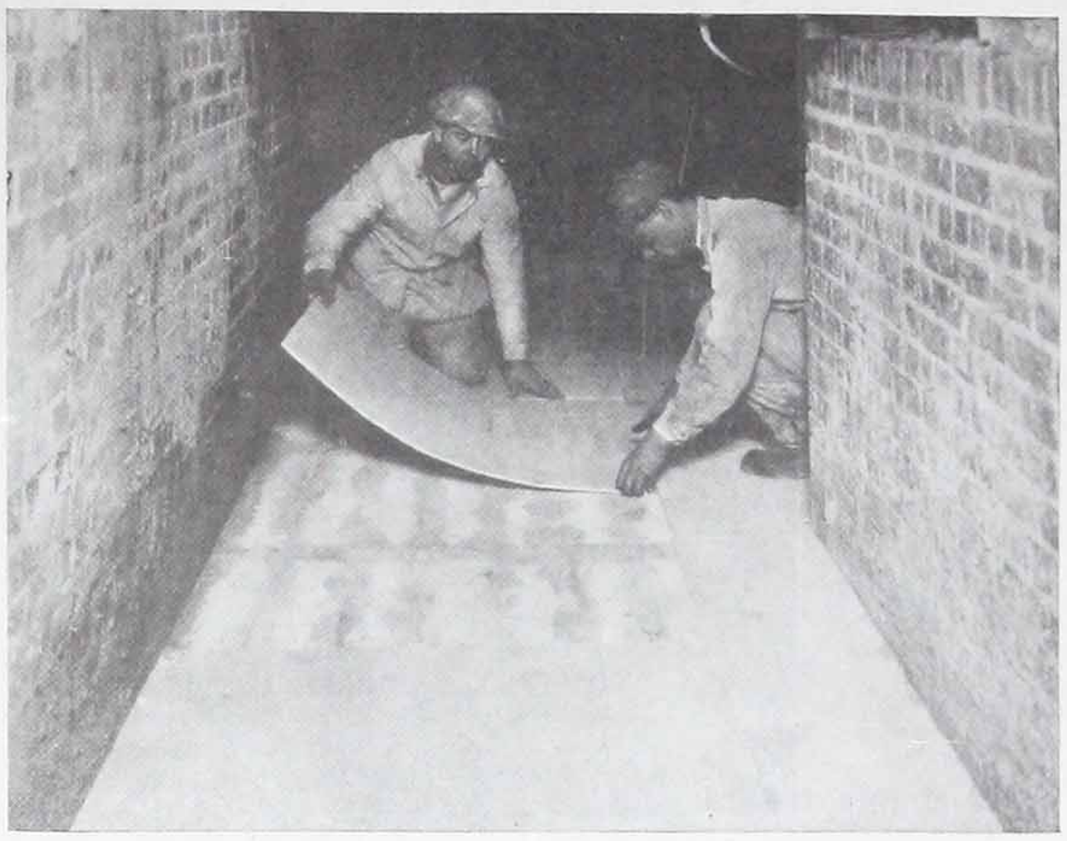
These three grades of Millboard are of still higher uality than No. 105 in grade of fibre and heat resisance. They will withstand temperatures up to about 000 deg. F. The difference between the three grades s that No. 101 is hard and stiff, No. 102 is of medium ardness and No. 103 is soft and pliable. Thicknesses 1/32″ to 1/2″.

lo. 101-S Millboard:

This grade is similar in composition to No. 101, ut is surface-treated to increase its hardness and lensity for conditions requiring an especially strong heet. It will withstand temperatures up to 1000 deg. F. Thicknesses 1/32″ to 1/2″.

-Stock Millboard:

This grade of Millboard contains an especially long grade of fibre and is used for a great many conditions where a board of unusual heat-resisting properties is required. It is generally suitable for use at temperatures up to 1200 deg. F. At higher temperatures than this it becomes quite brittle, but it has been successfully used for conditions where the temperatures ran as high as 1800 deg. F. and where brittleness was not a serious objection. Thicknesses 1/32″ to 1/2″.



Laying J-M Millboard over Superex blocks between side walls and brick pier in base of asphalt still

No. 219-S Millboard:

This is a particularly high grade Millboard, specially treated to give it somewhat greater density and strength. This grade is principally used for gaskets on hot oil, gas and tar lines, oil stills, etc. It is generally suitable for use at temperatures up to 1500 deg. F. Where loss of strength is not a serious objection, it can be used for temperatures up to 1800 deg. F. Thicknesses 1/32″ to 1/2″.

Average Uncrated Weights

Thickness, inches	Per sheet, 42″ x 43″, pounds	Per square ft., ounces
1/32	2.5	2.9
3/64	3.5	4.0
1/16	4.6	5.3
5/64	6.0	6.9
3/32	7.0	8.0
1/8	9.0	10.3
5/32	11.3	12.9
3/16	13.3	15.2
1/4	17.6	20.1
5/16	21.4	24.4
3/8	25.2	28.8
1/2	31.5	36.0
5/8	42.9	49.0
3/4	46.6	53.3

Actual weights and thicknesses may vary plus or minus 10 percent

A specially treated Millboard for use by glassworkers is available on special order in any grade except No. 101-S. Orders should specify "Glassworkers' Millboard" before the grade number.

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J-M Asbestos Paper and Roll Board

J-M Asbestos Paper and Roll Board are intended for use when an insulating material of minimum thickness is required.

Asbestos Paper is used principally in the manufacture of corrugated insulation in various forms. It is also used under the sewed-on canvas jacket over pipe insulation to provide a smooth surface for the canvas. Some use is found as a wrapping for furnace and heater pipes, although the extreme thinness of the paper, even when several wraps are applied, makes it necessarily less efficient as an insulation than Asbestocel in flexible roll form. In locations where little room is available, Asbestos Paper is also used as a protection against heat or as a fire retardant between walls, floors and ceilings.

Much Asbestos Paper is used in the manufacture of other products such as gaskets and protective pads, and as a dielectric in inexpensive domestic electrical appliances. Asbestos Paper has also many other uses the knowledge of which is limited to the industry in which it is utilized.

Rolls of Asbestos Paper, weighing 50 and 100 lb., are regularly furnished in widths of 18″, 24″, and 36″ (also 36″ to 37½″). Paper may also be ordered in other widths or in cut sheets or in 25-lb. rolls.

A 12-lb. Paper Tape is available in standard rolls 84 ft. long in 2″ and 3″ widths. Packages of the 2″ tape contain 18 rolls and of the 3″ tape, 12 rolls.

J-M Asbestos Roll Board is similar to Asbestos Paper but is used where a heavier material is required. It is furnished in standard rolls 18″ and 36″ wide, weighing 50 and 100 lb., and in special widths or in cu sheets to order.

Approximate weights and thicknesses of J-M Asbestos Paper and Roll Board are listed in the following table. If material is necessary which meets close tolerances than listed in the table, the nearest Johns Manville office should be consulted.

Asbestos Paper

Approx. thickness,* inches	Approx. weight** per 100 sq. ft., pounds
.015	6
.019	8
.022	10
.027	12
.029	14
.032	16
.0625	32

Asbestos Roll Board

3/32	48
1/8	64

*Actual thickness of Roll Board may vary ± .02″.
**The actual weights may vary ± 10 percent.

Special grades of J-M Asbestos Paper are supplied for various industrial uses. They are used as a dielectric in motors and other units subject to heat. Grades are available for the filtration of chemicals and for electrolytic cell diaphragms used in the manufacture of chlorine by electrolysis of brine.

Where high heat resistance and the elimination of objectionable fuming are required, as in welding and neon sign manufacture, the specific use of the paper should be stated on the order, as "Asbestos Paper for Welding" or "Asbestos Paper for Neon Signs."

Printed in U.S.A.

Asbesto-Sponge Felted Pipe Insulation

For temperatures to 700 deg. F.

Asbesto-Sponge Felted Insulation is the most efficient commercial heat insulation for pipes conveying steam or fluids, the temperatures of which do not exceed 700 deg. F.

It is especially designed to withstand, permanently and without disintegration, the high temperatures, as well as vibration and wear and tear, encountered in modern engineering practice.

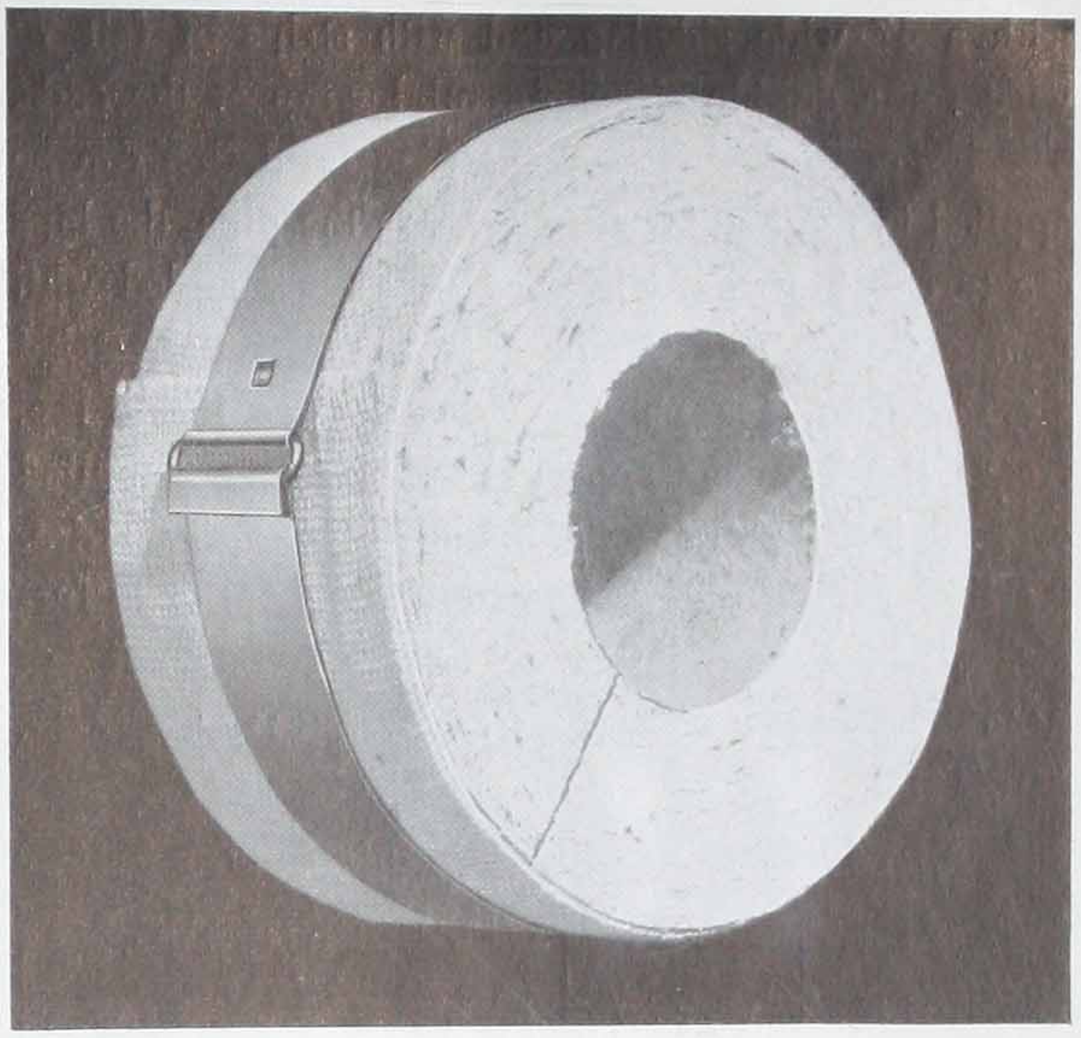
Constructed from felts composed of asbestos fibres and small particles of spongy cellular material, the insulation is built up to the required thickness in laminations about forty per inch of thickness, cemented together at intervals. For pipe insulation, these felts are wound one over the other until the desired thickness is obtained and the cylinder then split lengthwise to permit application.

The principal advantages of Asbesto-Sponge Felted Insulation over other types lie in its high efficiency and in the permanency with which it retains this high efficiency in service. Soaking Asbesto-Sponge Felted in water and then drying it out again has practically no effect upon its efficiency.

Its high insulating efficiency is due to its construction, which gives an enormously large number of very minute, completely enclosed air spaces. It is a well-known fact that small, completely enclosed air spaces provide the most effective form of insulation which is commercially available.

Asbesto-Sponge Felted, because it is fabricated, costs more than a moulded material. The cost of pipe insulation, however, is but a small part of the entire job. There are such items as cement, canvas, paste, sewing twine, paint, labor on pipe and fittings, expenses of mechanics, etc. The cost of an Asbesto-Sponge Felted job is therefore not much more than that of an 85% Magnesia job at the time of application, and is much less when the *constant* saving and sturdiness is considered. It is the cheapest *per year* heat insulation made.

The felted nature of Asbesto-Sponge Felted makes it flexible to a considerable extent, and the insulation before and after application will stand much abuse without becoming damaged. Being so constructed as to eliminate breakage in shipping, handling and after



applying, it can be removed and replaced many times without loss of insulating efficiency.

Asbesto-Sponge Felted is adaptable to all sizes of piping, with the minimum expenditure for labor. This applies particularly to large pipe sizes, where this insulation is furnished in one piece, and not in segments as are moulded forms of insulation.

Asbesto-Sponge Felted Insulation is furnished in 3-foot sections, in thicknesses from 1″ to 3″, to fit accurately any commercial size of pipe, finished with a canvas jacket and furnished with lacquered bands for holding in place. The 3″ thickness is furnished in two-layer construction, unless solid construction is specified. Thicknesses less than 3″ are furnished solid, unless otherwise specified.

Being split on but one side only, for pipe sizes 3″ and larger, the heat leakage through joints is reduced to the minimum, and application is made easier.

Asbesto-Sponge Felted can also be supplied in sections to fit straight runs of copper pipe or tubing with the following outside diameters: 3/8″, 1/2″, 5/8″, 7/8″, 1 1/8″, 1 3/8″, 1 5/8″, 2 1/8″, 2 5/8″, 3 1/8″, 3 5/8″, 4 1/8″, 5 1/8″ and 6 1/8″.

Asbesto-Sponge Felted Insulation is also furnished in sheet or block form in a number of convenient sizes as described in another data sheet.

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Waterproof Asbestos Jacket

Asbesto-Sponge Felted Pipe Insulation can be furnished with an integral waterproof asbestos jacket attached at the factory. This 3-ply jacket is supplied with a 4″ wide side-lap and with strips of felt 7″ wide for a double circumferential wrap at the ends. The jacket is split so that the pipe insulation can be applied in the regular manner. On the pipe, the laps are turned downward to shed water and sealed with Laptite.* The side-laps of circumferential strips are made on the opposite side from the jacket lap. No. 16 B & S gauge Copperweld wire rings are applied over the jacket on not more than 4″ centers. This wire, together with copperized staples and Laptite is furnished with the insulation.

*An asphaltic cement furnished in ½, 1, 5, 25 and 50-gal. containers.

Permeable Asbestos Jacket**

For use where subjected to inundations, Asbesto-Sponge Felted can be furnished with a water-permeable jacket of wire-inserted asbestos cloth. This permits the escape of water or steam from the pipe insulation without disruption of the covering.

The jacket, which is attached to the pipe insulation, is provided with a 4″ circumferential lap at one end, and two 4″ laps over the longitudinal joint. When the insulation is applied, the longitudinal laps are held together, folded double and sewn to the jacket, as is also the end lap. Copper wire or wire-inserted asbestos cord is used for stitching, together with copperized staples and No. 16 B & S gauge Copperweld wire for holding the insulation on 4″ centers.

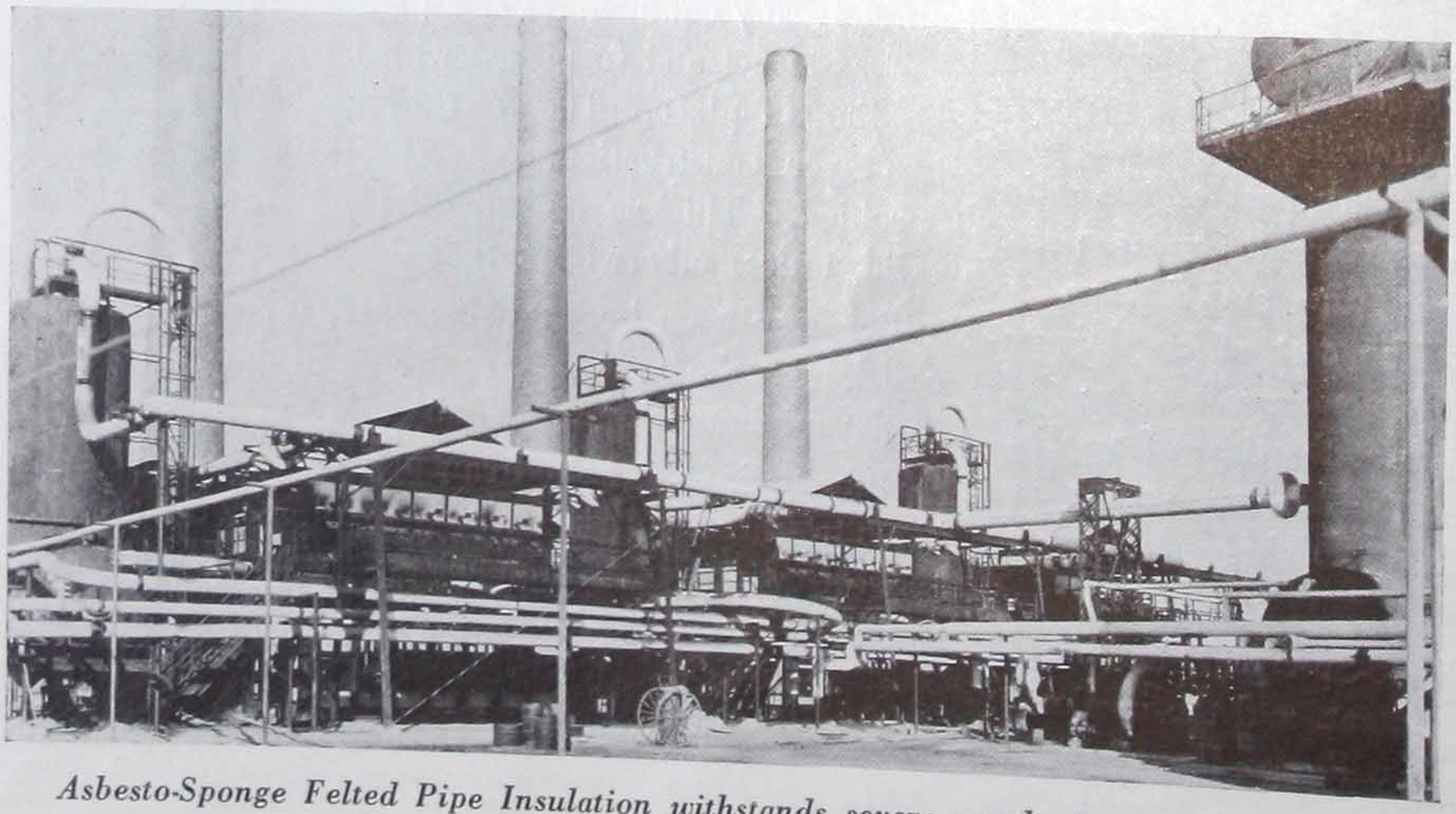
**U. S. Patent No. 2,023,985.

Thickness Recommendations

Steam pressure or condition	Temperature, degrees F.	Thickness of insulation, inches		
		Pipes larger than 4″	Pipes 2″ to 4″	Pipes smaller than 2″
Hot Water	.....	1	1	1
0 to 25 lb.	212 to 266	1	1	1
25 to 100 lb.	267 to 337	1½	1	1
100 to 200 lb.	338 to 387	2	1½	1
Low Superheat	388 to 499	2½	2	1½
Superheat	500 to 599	3	2½	2
High Superheat	600 to 700	3½	3	2

Carton Contents and Weights of 1″ Thickness

Pipe size, inches	Approx. wgt. per section	No. of sections	Insulation, feet	Approx. gross weight, lb
½	4.3	28	84	118
¾	4.7	24	72	110
1	5.2	20	60	103
1¼	5.7	17	51	99
1½	6.2	15	45	94
2	7.6	12	36	90
2½	9.2	11	33	96
3	9.8	8	24	73
3½	11.5	6	18	74
4	12.6	6	18	81
4½	13.7	5	15	74
5	15.0	3	9	49



Asbesto-Sponge Felted Pipe Insulation withstands severe weathering on outdoor lines as well as the vibration and shock of mechanical impact

Approximate Weigh

lb. per section, uncrated*

Pipe size, inches	Thickness, inches		
	1½″	2″	3
½	8.9	13.0	25
¾	9.5	13.6	26
1	10.4	14.8	28
1¼	11.4	16.2	29
1½	12.0	17.0	31
2	13.3	18.8	34
2½	14.7	20.7	37
3	16.5	23.1	41
3½	17.9	25.2	43
4	19.4	27.1	46
4½	20.8	29.0	49
5	22.7	31.5	53
6	25.6	35.2	59
7	28.3	39.1	65
8	31.0	43.0	70
9	34.0	47.5	76
10	37.2	51.3	83
12	43.0	59.2	95

*To estimate crated weights add 20 percent.

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Asbesto-Sponge Felted (sectional) Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot of pipe surface, per degree temperature difference, per hour.
Efficiency expressed in percent of bare pipe losses.

Insulation thickness, inches		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
Nominal pipe size ½″											
1	Heat Loss, B.t.u.	.619	.638	.658	.677	.697	.717	.738	.758	.779	.800
	Efficiency %	68.26	70.36	72.59	74.60	76.39	78.00	79.65	81.20	82.55	83.74
1½	Heat Loss, B.t.u.	.566	.583	.601	.618	.636	.654	.673	.691	.710	.729
	Efficiency %	70.98	72.91	74.95	76.80	78.45	79.92	81.44	82.86	84.09	85.19
2	Heat Loss, B.t.u.	.507	.522	.538	.553	.569	.585	.602	.618	.635	.652
	Efficiency %	74.00	75.78	77.59	79.24	80.72	82.05	83.40	84.70	85.77	86.75
2½	Heat Loss, B.t.u.	.473	.486	.500	.513	.527	.541	.555	.570	.585	.600
	Efficiency %	75.73	77.41	79.18	80.75	82.15	83.43	84.70	85.86	86.90	87.80
3	Heat Loss, B.t.u.	.439	.452	.465	.478	.492	.505	.519	.533	.547	.562
	Efficiency %	77.49	79.00	80.62	82.06	83.32	84.51	85.69	86.80	87.75	88.56
Nominal pipe size ¾″											
1	Heat Loss, B.t.u.	.565	.582	.599	.617	.635	.653	.672	.690	.709	.728
	Efficiency %	71.02	72.96	75.03	76.82	78.49	79.97	81.46	82.90	84.11	85.21
1½	Heat Loss, B.t.u.	.509	.524	.540	.555	.571	.587	.604	.620	.637	.654
	Efficiency %	73.90	75.66	77.50	79.17	80.65	82.00	83.35	84.65	85.73	86.71
2	Heat Loss, B.t.u.	.453	.466	.480	.493	.507	.521	.536	.550	.565	.580
	Efficiency %	76.77	78.37	80.00	81.50	82.82	84.03	85.22	86.37	87.34	88.21
2½	Heat Loss, B.t.u.	.419	.430	.442	.453	.465	.477	.490	.502	.515	.528
	Efficiency %	78.51	80.04	81.59	83.00	84.25	85.36	86.49	87.56	88.45	89.26
3	Heat Loss, B.t.u.	.384	.395	.407	.418	.430	.442	.455	.467	.480	.493
	Efficiency %	80.30	81.65	83.05	84.30	85.44	86.45	87.45	88.42	89.25	89.98
Nominal pipe size 1″											
1	Heat Loss, B.t.u.	.508	.524	.540	.556	.573	.589	.606	.623	.641	.658
	Efficiency %	73.94	75.66	77.50	79.15	80.59	81.95	83.29	84.55	85.64	86.62
1½	Heat Loss, B.t.u.	.457	.471	.485	.499	.514	.528	.543	.558	.574	.589
	Efficiency %	76.57	78.11	79.79	81.26	82.59	83.80	85.02	86.16	87.14	88.02
2	Heat Loss, B.t.u.	.401	.413	.425	.437	.450	.462	.475	.488	.502	.515
	Efficiency %	79.42	80.83	82.30	83.60	84.75	85.84	86.90	87.90	88.75	89.53
2½	Heat Loss, B.t.u.	.370	.380	.390	.400	.411	.421	.432	.443	.455	.466
	Efficiency %	81.02	82.35	83.75	85.00	86.07	87.09	88.09	89.02	89.80	90.53
3	Heat Loss, B.t.u.	.340	.350	.360	.370	.381	.391	.402	.413	.424	.435
	Efficiency %	82.56	83.75	85.00	86.11	87.09	88.00	88.91	89.76	90.50	91.16
Nominal pipe size 1¼″											
1	Heat Loss, B.t.u.	.467	.481	.496	.510	.525	.540	.556	.571	.587	.603
	Efficiency %	76.05	77.68	79.32	80.85	82.21	83.45	84.66	85.84	86.85	87.75
1½	Heat Loss, B.t.u.	.415	.427	.440	.452	.465	.478	.492	.505	.519	.533
	Efficiency %	78.71	80.16	81.66	83.04	84.25	85.36	86.43	87.49	88.37	89.16
2	Heat Loss, B.t.u.	.370	.380	.391	.401	.412	.423	.435	.446	.458	.470
	Efficiency %	81.02	82.35	83.71	84.97	86.05	87.03	88.00	88.95	89.74	90.45
2½	Heat Loss, B.t.u.	.328	.337	.347	.356	.366	.376	.387	.397	.408	.419
	Efficiency %	83.17	84.35	85.55	86.64	87.60	88.46	89.32	90.16	90.85	91.49
3	Heat Loss, B.t.u.	.301	.310	.319	.328	.338	.347	.357	.367	.378	.388
	Efficiency %	84.56	85.60	86.71	87.70	88.55	89.36	90.15	90.90	91.53	92.12
Nominal pipe size 1½″											
1	Heat Loss, B.t.u.	.444	.458	.472	.486	.501	.515	.530	.545	.561	.576
	Efficiency %	77.22	78.71	80.34	81.78	83.02	84.20	85.38	86.50	87.43	88.30
1½	Heat Loss, B.t.u.	.392	.404	.416	.428	.441	.453	.466	.479	.493	.506
	Efficiency %	79.90	81.24	82.67	83.94	85.05	86.09	87.14	88.14	88.95	89.70
2	Heat Loss, B.t.u.	.341	.351	.361	.371	.382	.392	.403	.414	.426	.437
	Efficiency %	82.50	83.73	84.95	86.08	87.05	87.97	88.88	89.74	90.45	91.12
2½	Heat Loss, B.t.u.	.307	.316	.325	.334	.344	.353	.363	.373	.384	.394
	Efficiency %	84.25	85.33	86.45	87.46	88.34	89.17	89.99	90.75	91.39	92.00
3	Heat Loss, B.t.u.	.280	.288	.297	.305	.314	.323	.333	.342	.352	.362
	Efficiency %	85.64	86.64	87.62	88.55	89.35	90.09	90.82	91.52	92.12	92.64
Nominal pipe size 2″											
1	Heat Loss, B.t.u.	.414	.427	.440	.453	.467	.480	.494	.508	.523	.537
	Efficiency %	78.78	80.16	81.66	83.00	84.18	85.28	86.37	87.41	88.27	89.07
1½	Heat Loss, B.t.u.	.361	.372	.384	.395	.407	.419	.432	.444	.457	.470
	Efficiency %	81.49	82.73	84.00	85.19	86.20	87.15	88.09	89.00	89.76	90.45
2	Heat Loss, B.t.u.	.312	.321	.330	.339	.349	.358	.368	.378	.389	.399
	Efficiency %	84.00	85.09	86.25	87.26	88.17	89.02	89.85	90.64	91.28	91.90
2½	Heat Loss, B.t.u.	.279	.287	.295	.303	.312	.320	.329	.338	.348	.357
	Efficiency %	85.69	86.66	87.70	88.64	89.43	90.18	90.93	91.63	92.20	92.75
3	Heat Loss, B.t.u.	.254	.261	.269	.276	.284	.292	.300	.309	.318	.327
	Efficiency %	86.97	87.87	88.79	89.64	90.37	91.04	91.73	92.34	92.88	93.36

Insulation thickness, inches		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
Nominal pipe size 2½″											
1	Heat Loss, B.t.u.	.391	.403	.416	.428	.441	.454	.468	.481	.495	.509
	Efficiency %	79.95	81.30	82.67	83.94	85.05	86.07	87.10	88.08	88.91	89.65
1½	Heat Loss, B.t.u.	.339	.349	.360	.370	.381	.392	.403	.414	.426	.437
	Efficiency %	82.60	83.80	85.00	86.11	87.09	87.97	88.88	89.74	90.45	91.12
2	Heat Loss, B.t.u.	.291	.299	.308	.316	.325	.334	.344	.353	.363	.373
	Efficiency %	85.07	86.11	87.16	88.14	88.99	89.75	90.52	91.26	91.87	92.42
2½	Heat Loss, B.t.u.	.259	.266	.273	.280	.288	.295	.303	.311	.320	.328
	Efficiency %	86.71	87.65	88.62	89.50	90.24	90.95	91.65	92.30	92.83	93.34
3	Heat Loss, B.t.u.	.236	.242	.249	.255	.262	.269	.277	.284	.292	.300
	Efficiency %	87.90	88.76	89.63	90.43	91.12	91.74	92.36	92.96	93.46	93.91
Nominal pipe size 3″											
1	Heat Loss, B.t.u.	.372	.383	.395	.406	.418	.430	.442	.454	.467	.479
	Efficiency %	80.92	82.20	83.54	84.76	85.84	86.80	87.81	88.75	89.54	90.26
1½	Heat Loss, B.t.u.	.321	.331	.341	.351	.361	.371	.382	.392	.403	.414
	Efficiency %	83.54	84.62	85.80	86.84	87.76	88.62	89.46	90.29	90.97	91.59
2	Heat Loss, B.t.u.	.272	.280	.288	.296	.305	.313	.322	.331	.341	.350
	Efficiency %	86.05	87.00	88.00	88.90	89.66	90.40	91.12	91.80	92.36	92.90
2½	Heat Loss, B.t.u.	.239	.246	.253	.260	.268	.275	.283	.290	.298	.306
	Efficiency %	87.74	88.56	89.46	90.25	90.92	91.56	92.20	92.82	93.32	93.78
3	Heat Loss, B.t.u.	.217	.223	.230	.236	.243	.249	.256	.263	.271	.278
	Efficiency %	88.87	89.64	90.41	91.14	91.77	92.36	92.94	93.48	93.93	94.35
Nominal pipe size 3½″											
1	Heat Loss, B.t.u.	.360	.371	.383	.394	.406	.418	.431	.443	.456	.469
	Efficiency %	81.54	82.26	84.04	85.21	86.25	87.17	88.11	89.02	89.78	90.46
1½	Heat Loss, B.t.u.	.309	.318	.328	.337	.347	.357	.368	.378	.389	.400
	Efficiency %	84.15	85.22	86.34	87.35	88.24	89.05	89.85	90.64	91.28	91.88
2	Heat Loss, B.t.u.	.262	.269	.277	.284	.292	.300	.309	.317	.326	.335
	Efficiency %	86.55	87.50	88.45	89.35	90.11	90.80	91.48	92.14	92.70	93.20
2½	Heat Loss, B.t.u.	.228	.235	.242	.249	.256	.263	.271	.278	.286	.294
	Efficiency %	88.30	89.08	89.92	90.66	91.33	91.93	92.53	93.12	93.59	94.02
3	Heat Loss, B.t.u.	.204	.210	.216	.222	.229	.235	.242	.249	.257	.264
	Efficiency %	89.54	90.23	91.00	91.67	92.24	92.80	93.33	93.84	94.24	94.64
Nominal pipe size 4″											
1	Heat Loss, B.t.u.	.350	.361	.372	.383	.395	.406	.418	.430	.443	.455
	Efficiency %	82.05	83.24	84.50	85.60	86.61	87.55	88.47	89.35	90.08	90.75
1½	Heat Loss, B.t.u.	.300	.309	.319	.328	.338	.347	.357	.367	.378	.388
	Efficiency %	84.61	85.65	86.71	87.70	88.55	89.36	90.15	90.90	91.53	92.12
2	Heat Loss, B.t.u.	.252	.259	.267	.274	.282	.290	.298	.306	.315	.323
	Efficiency %	87.07	87.96	88.87	89.71	90.45	91.10	91.78	92.42	92.94	93.44
2½	Heat Loss, B.t.u.	.220	.226	.233	.239	.246	.253	.260	.267	.275	.282
	Efficiency %	88.71	89.50	90.29	91.04	91.67	92.24	92.83	93.38	93.84	94.27
3	Heat Loss, B.t.u.	.197	.203	.209	.215	.221	.227	.234	.240	.247	.254
	Efficiency %	89.90	90.56	91.29	91.94	92.52	93.04	93.55	94.06	94.46	94.84
Nominal pipe size 4½″											
1	Heat Loss, B.t.u.	.345	.356	.367	.378	.389	.400	.412	.424	.436	.448
	Efficiency %	82.30	83.46	84.70	85.80	86.82	87.74	88.64	89.50	90.23	90.90
1½	Heat Loss, B.t.u.	.291	.300	.309	.318	.328	.337	.347	.357	.368	.378
	Efficiency %	85.07	86.06	87.12	88.06	88.89	89.66	90.43	91.15	91.75	92.32
2	Heat Loss, B.t.u.	.245	.252	.260	.267	.275	.282	.290	.297	.305	.313
	Efficiency %	87.44	88.30	89.16	89.98	90.69	91.35	92.00	92.64	93.16	93.64
2½	Heat Loss, B.t.u.	.214	.220	.226	.232	.239	.245	.252	.259	.267	.274
	Efficiency %	89.02	89.78	90.58	91.30	91.90	92.48	93.05	93.58	94.02	94.44
3	Heat Loss, B.t.u.	.191	.196	.202	.207	.213	.219	.226	.232	.239	.246
	Efficiency %	90.20	90.90	91.58	92.24	92.78	93.28	93.77	94.26	94.64	95.00
Nominal pipe size 5″											
1	Heat Loss, B.t.u.	.337	.347	.358	.368	.379	.390	.401	.412	.424	.435
	Efficiency %	82.72	83.89	85.09	86.18	87.15	88.04	88.94	89.78	90.50	91.16
1½	Heat Loss, B.t.u.	.286	.295	.304	.313	.322	.331	.341	.350	.360	.370
	Efficiency %	85.34	86.30	87.34	88.25	89.09	89.85	90.60	91.32	91.94	92.48
2	Heat Loss, B.t.u.	.238	.245	.252	.259	.267	.274	.282	.289	.297	.305
	Efficiency %	87.79	88.62	89.50	90.28	90.95	91.60	92.22	92.84	93.35	93.80
2½	Heat Loss, B.t.u.	.207	.213	.219	.225	.232	.238	.245	.251	.258	.265
	Efficiency %	89.38	90.10	90.87	91.56	92.14	92.70	93.24	93.78	94.22	94.62
3	Heat Loss, B.t.u.	.185	.190	.196	.201	.207	.212	.218	.224	.231	.237
	Efficiency %	90.51	91.18	91.84	92.46	92.99	93.48	93.99	94.45	94.82	95.18

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ASBESTO-SPONGE FELTED (SECTIONAL)
HEAT LOSSES AND EFFICIENCIES *(continued)*

Heat losses expressed in B.t.u. per square foot of pipe surface, per degree temperature difference, per hour.
Efficiency expressed in percent of bare pipe losses.

Insulation thickness, inches		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
		Nominal pipe size 6"									
1	Heat Loss, B.t.u.	.327	.337	.348	.358	.369	.379	.390	.401	.413	.424
	Efficiency %	83.24	84.35	85.50	86.55	87.50	88.37	89.25	90.06	90.75	91.28
1½	Heat Loss, B.t.u.	.277	.285	.294	.302	.311	.320	.330	.339	.349	.359
	Efficiency %	85.75	86.76	87.75	88.66	89.46	90.18	90.90	91.60	92.18	92.70
2	Heat Loss, B.t.u.	.228	.235	.242	.249	.256	.263	.270	.277	.285	.292
	Efficiency %	88.30	89.08	89.92	90.66	91.33	91.93	92.56	93.14	93.62	94.07
2½	Heat Loss, B.t.u.	.198	.203	.209	.214	.220	.226	.233	.239	.246	.253
	Efficiency %	89.85	90.56	91.29	91.98	92.54	93.06	93.57	94.08	94.49	94.86
3	Heat Loss, B.t.u.	.176	.181	.186	.191	.196	.201	.207	.213	.220	.226
	Efficiency %	90.98	91.60	92.25	92.84	93.36	93.84	94.39	94.72	95.07	95.41
		Nominal pipe size 7"									
1	Heat Loss, B.t.u.	.322	.332	.342	.352	.363	.373	.384	.395	.407	.418
	Efficiency %	83.48	84.60	85.75	86.82	87.70	88.56	89.69	90.21	90.89	91.50
1½	Heat Loss, B.t.u.	.269	.277	.286	.294	.303	.311	.320	.329	.339	.348
	Efficiency %	86.20	87.14	88.08	88.96	89.74	90.46	91.17	91.84	92.40	92.93
2	Heat Loss, B.t.u.	.222	.228	.235	.241	.248	.255	.262	.269	.276	.284
	Efficiency %	88.61	89.40	90.21	90.96	91.60	92.18	92.78	93.34	93.82	94.23
2½	Heat Loss, B.t.u.	.191	.196	.202	.207	.213	.219	.225	.231	.238	.244
	Efficiency %	90.20	90.90	91.58	92.24	92.78	93.28	93.80	94.28	94.67	95.04
3	Heat Loss, B.t.u.	.169	.174	.179	.184	.189	.194	.200	.205	.211	.217
	Efficiency %	91.33	91.92	92.55	93.10	93.60	94.05	94.49	94.92	95.27	95.59

Insulation thickness, inches		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375	425	475	525	5
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	5
		Nominal pipe size 8"									
1	Heat Loss, B.t.u.	.314	.324	.334	.344	.354	.364	.375	.386	.398	.4
	Efficiency %	83.90	84.95	86.08	87.10	88.00	88.84	89.65	90.44	91.08	91.
1½	Heat Loss, B.t.u.	.264	.272	.280	.288	.297	.305	.314	.323	.333	.3
	Efficiency %	86.45	87.36	88.33	89.20	89.94	90.64	91.34	92.00	92.54	93.
2	Heat Loss, B.t.u.	.217	.223	.230	.236	.243	.249	.256	.263	.271	.2
	Efficiency %	88.87	89.64	90.41	91.14	91.77	92.36	92.94	93.48	93.93	94.
2½	Heat Loss, B.t.u.	.186	.191	.197	.202	.208	.213	.219	.225	.232	.2
	Efficiency %	90.46	91.13	91.79	92.44	92.95	93.46	93.96	94.43	94.80	95.
3	Heat Loss, B.t.u.	.165	.169	.174	.178	.183	.188	.194	.199	.205	.2
	Efficiency %	91.54	92.16	92.75	93.32	93.80	94.24	94.65	95.07	95.41	95.
		Nominal pipe size 9"									
1	Heat Loss, B.t.u.	.312	.321	.331	.341	.351	.362	.373	.384	.395	.4
	Efficiency %	84.00	85.09	86.20	87.20	88.10	88.90	89.72	90.49	91.15	91.
1½	Heat Loss, B.t.u.	.261	.269	.277	.285	.294	.302	.311	.319	.328	.3
	Efficiency %	86.61	87.50	88.45	89.30	90.04	90.74	91.42	92.10	92.65	93.
2	Heat Loss, B.t.u.	.213	.219	.225	.232	.239	.245	.252	.259	.267	.2
	Efficiency %	89.08	89.81	90.62	91.30	91.90	92.48	93.05	93.58	94.02	94.
2½	Heat Loss, B.t.u.	.182	.187	.192	.197	.203	.208	.214	.220	.227	.2
	Efficiency %	90.66	91.32	92.00	92.61	93.12	93.62	94.10	94.55	94.91	95.
3	Heat Loss, B.t.u.	.161	.165	.170	.174	.179	.184	.189	.194	.200	.2
	Efficiency %	91.74	92.34	92.92	93.47	93.94	94.36	94.79	95.19	95.52	95.

Insulation thickness, inches		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
		Nominal pipe size 10"									
1½	Heat Loss, B.t.u.	.255	.263	.271	.279	.287	.295	.304	.312	.321	.330
	Efficiency %	86.92	87.79	88.70	89.53	90.27	90.95	91.62	92.26	92.80	93.30
2	Heat Loss, B.t.u.	.209	.215	.221	.227	.234	.240	.247	.253	.260	.267
	Efficiency %	89.29	90.02	90.79	91.48	92.07	92.64	93.19	93.74	94.17	94.58
2½	Heat Loss, B.t.u.	.178	.183	.188	.193	.199	.204	.210	.215	.221	.227
	Efficiency %	90.87	91.50	92.16	92.76	93.26	93.74	94.21	94.68	95.04	95.39
3	Heat Loss, B.t.u.	.157	.161	.165	.169	.174	.178	.183	.188	.194	.199
	Efficiency %	91.95	92.52	93.13	93.66	94.10	94.54	94.95	95.34	95.65	95.96
		Nominal pipe size 12"									
1½	Heat Loss, B.t.u.	.252	.259	.267	.274	.282	.290	.299	.307	.316	.325
	Efficiency %	87.07	87.96	88.87	89.71	90.45	91.10	91.75	92.40	92.92	93.40
2	Heat Loss, B.t.u.	.205	.210	.216	.222	.228	.234	.241	.247	.254	.261
	Efficiency %	89.50	90.23	91.00	91.67	92.28	92.82	93.36	93.88	94.30	94.70
2½	Heat Loss, B.t.u.	.173	.178	.183	.188	.193	.198	.204	.209	.215	.221
	Efficiency %	91.13	91.74	92.37	92.94	93.46	93.92	94.38	94.82	95.18	95.51
3	Heat Loss, B.t.u.	.152	.156	.160	.164	.169	.173	.178	.182	.187	.192
	Efficiency %	92.20	92.76	93.34	93.84	94.28	94.69	95.09	95.49	95.81	96.10
		Nominal pipe size 14"									
1½	Heat Loss, B.t.u.	.249	.256	.264	.271	.279	.287	.295	.303	.312	.320
	Efficiency %	87.22	88.10	89.00	89.83	90.55	91.20	91.86	92.50	93.00	93.50
2	Heat Loss, B.t.u.	.202	.207	.213	.218	.224	.230	.236	.242	.249	.255
	Efficiency %	89.64	90.38	91.12	91.82	92.42	92.95	93.50	94.00	94.42	94.82
2½	Heat Loss, B.t.u.	.172	.176	.181	.185	.190	.195	.201	.206	.212	.218
	Efficiency %	91.18	91.83	92.46	93.06	93.56	94.02	94.47	94.90	95.24	95.57
3	Heat Loss, B.t.u.	.150	.154	.158	.162	.166	.170	.175	.179	.184	.189
	Efficiency %	92.31	92.85	93.42	93.92	94.38	94.78	95.18	95.57	95.88	96.16
		Nominal pipe size 16"									
1½	Heat Loss, B.t.u.	.247	.254	.262	.269	.277	.282	.292	.300	.309	.317
	Efficiency %	87.34	88.20	89.08	89.90	90.61	91.29	91.95	92.57	93.08	93.56
2	Heat Loss, B.t.u.	.201	.206	.212	.217	.223	.228	.234	.240	.247	.253
	Efficiency %	89.69	90.44	91.16	91.86	92.45	93.00	93.55	94.06	94.46	94.86
2½	Heat Loss, B.t.u.	.170	.174	.179	.183	.188	.193	.198	.203	.209	.214
	Efficiency %	91.28	91.92	92.55	93.12	93.63	94.08	94.54	94.97	95.32	95.65
3	Heat Loss, B.t.u.	.149	.152	.156	.159	.163	.167	.172	.176	.181	.186
	Efficiency %	92.36	92.94	93.50	94.03	94.48	94.88	95.26	95.64	95.94	96.22
		Nominal pipe size 18"									
1½	Heat Loss, B.t.u.	.245	.252	.259	.266	.274	.281	.289	.297	.306	.314
	Efficiency %	87.44	88.30	89.21	90.02	90.72	91.38	92.03	92.64	93.14	93.62
2	Heat Loss, B.t.u.	.200	.205	.210	.215	.221	.226	.232	.238	.245	.251
	Efficiency %	89.74	90.48	91.25	91.94	92.52	93.06	93.60	94.10	94.51	94.90
2½	Heat Loss, B.t.u.	.167	.171	.176	.180	.185	.189	.194	.199	.205	.210
	Efficiency %	91.44	92.06	92.66	93.24	93.73	94.20	94.65	95.07	95.41	95.73
3	Heat Loss, B.t.u.	.147	.150	.154	.157	.161	.165	.169	.173	.178	.182
	Efficiency %	92.46	93.04	93.58	94.11	94.55	94.94	95.34	95.71	96.01	96.30

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J-M 85% Magnesia Pipe Insulation

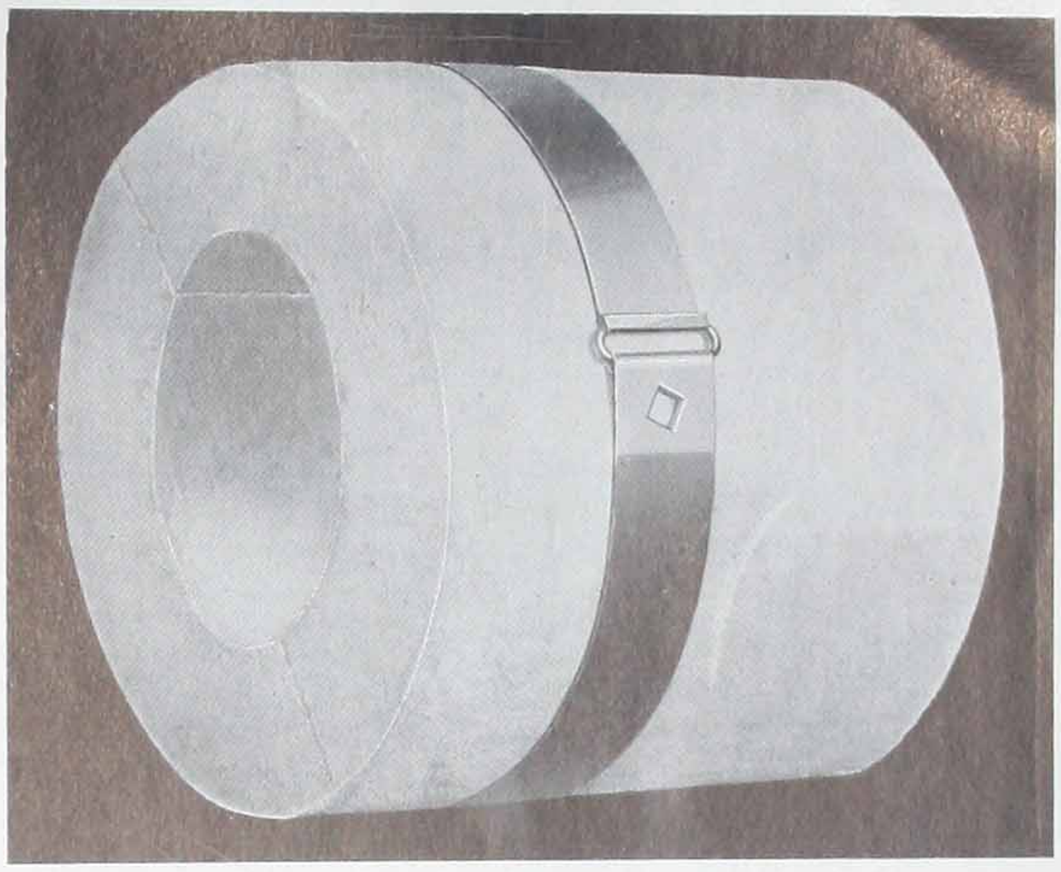
For temperatures to 600 deg. F.

J-M 85% Magnesia Insulation, suitable for temperatures up to 600 deg. F., combines the high insulating qualities of carbonate of magnesia and asbestos, affording a light, efficient insulation.

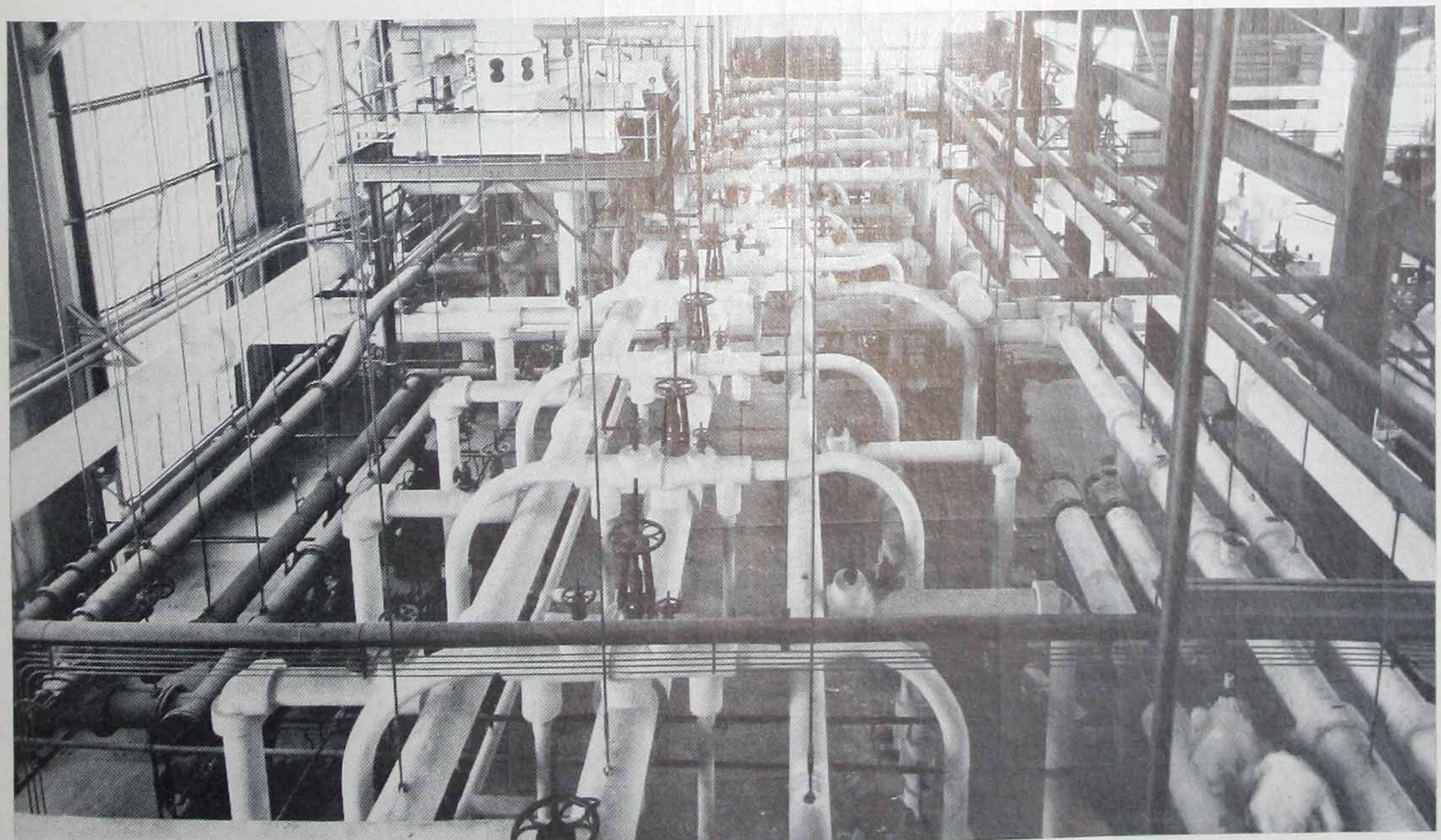
Under actual service conditions, J-M 85% Magnesia has proved to be the most durable and efficient insulation of the moulded type. The J-M manufacturing process produces an 85% Magnesia with the maximum number of voids or minute dead-air cells which increase its natural resistance to heat transmission and reduce its weight. In addition, it provides maximum mechanical strength consistent with high insulating efficiency.

85% Magnesia Pipe Insulation is moulded in 3-ft. lengths, in the following thicknesses: Standard, 1½″, 2″, 2½″, Double Standard, and 3″ (double layer), to fit standard pipe sizes. The thicknesses of Standard and Double Standard for various pipe sizes are shown on the reverse of this sheet.

85% Magnesia Pipe Insulation for smaller pipe sizes is furnished in sectional form, packed in crates or cartons with canvas jacket and metal bands. When ordered without canvas jacket, sectional insulation is wrapped in kraft paper.



Insulation for larger pipe sizes is furnished in segmental form, without canvas or bands. Equal segments are supplied approximately 5″ wide along the inner arc. Odd width segments, where necessary, are of the proper width to complete the circumference of the particular pipe size. The form in which the various sizes of 85% Magnesia Pipe Insulation is furnished is shown on the reverse of this sheet.



J-M 85% Magnesia on the steam lines of the Newgulf plant of the Texas Gulf Sulphur Company

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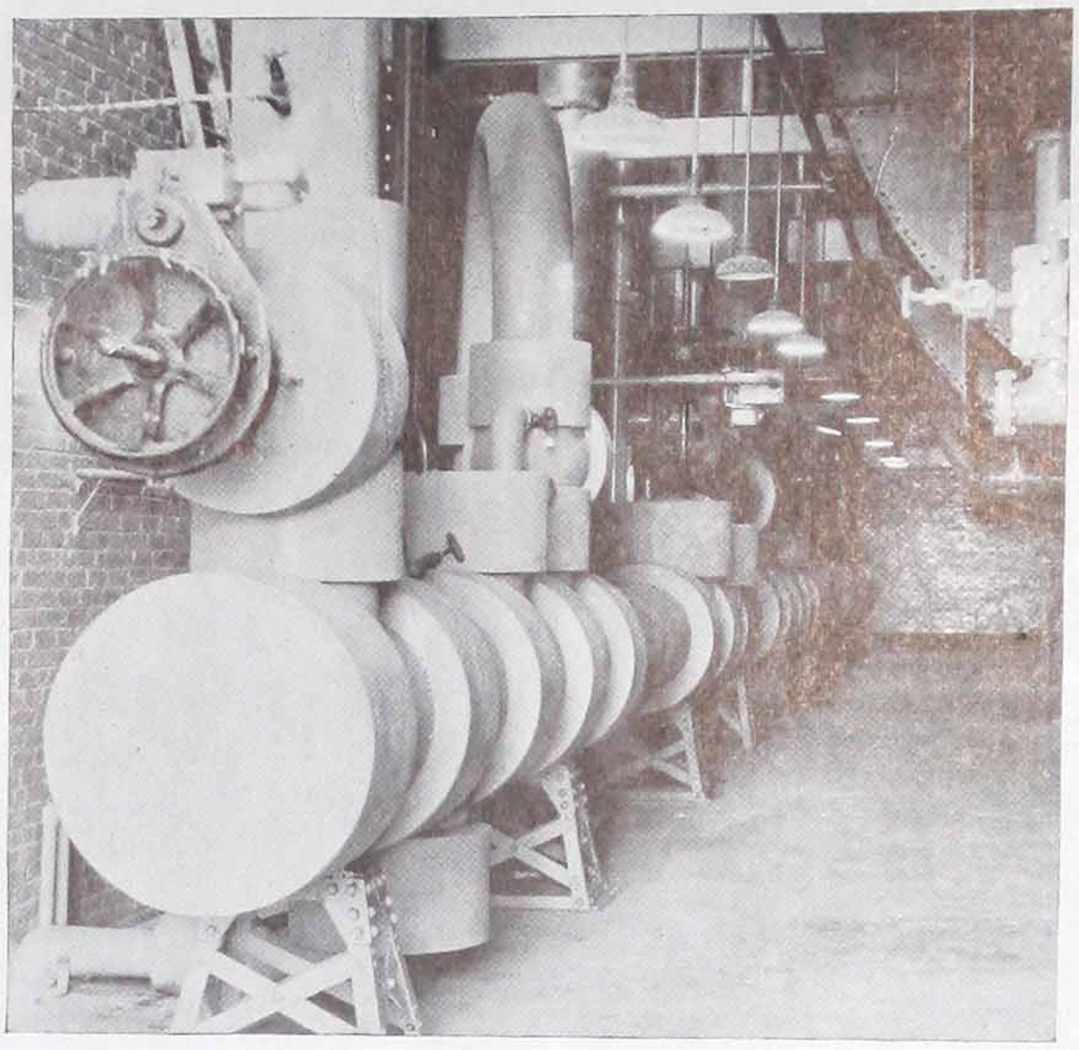

J-M 85% Magnesia Pipe Insulation on main steam header

The terms Standard Thick and Double Standard Thick apply only to 85% Magnesia Pipe Insulation Double Standard is furnished in two layers, each layer Standard thick. The table gives actual thickness of Standard and Double Standard Thick Magnesia.

Pipe size, inches	Standard thick, inches	Double Standard thick, inches	Pipe size, inches	Standard thick, inches	Double Standard thick, inches
½	⅞	1¾	6	1⅛	2¼
¾	⅞	1¾	7	1¼	2½
1	⅞	1¾	8	1¼	2½
1¼	⅞	1¾	9	1¼	2½
1½	⅞	1¾	10	1¼	2½
2	1 1/32	2 1/16	12	1½	3
2½	1 1/32	2 1/16	14	1½	3
3	1 1/32	2 1/16	16	1½	3
3½	1 1/32	2 1/16	18	1½	3
4	1⅛	2¼	20	1½	3
4½	1⅛	2¼	24	1½	3
5	1⅛	2¼	30	1½	3

Also furnished in the forms of block and lagging as described in another data sheet.

Weight in pounds per standard 3-foot section, uncrated

Thickness, inches	Nominal pipe sizes, inches																	
	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12
Std.	1.62	1.85	2.02	2.39	2.74	3.77	4.30	5.0	5.57	6.83	7.42	8.05	9.35	11.9	13.2	14.5	16.1	23.0
1½	3.77	4.12	4.59	5.10	5.52	6.27	7.16	8.1	8.88	9.70	10.50	11.40	13.10	14.7	16.3	18.0	19.8	23.0
Dbl. Std.	4.86	5.31	5.80	6.42	7.23	9.82	10.90	12.3	13.40	16.40	17.60	19.00	21.50	27.3	29.9	32.6	35.7	50.7
2	6.11	6.75	7.30	7.89	8.40	9.42	10.60	11.9	12.90	14.00	15.20	16.40	18.60	20.8	23.0	25.1	27.5	31.6
2½	8.95	9.80	10.50	11.25	11.90	13.20	14.50	16.1	17.40	18.80	20.00	21.55	24.50	27.3	29.9	32.6	35.7	40.9
3	12.40	13.20	14.00	15.20	16.00	17.40	19.10	21.1	22.60	24.20	25.90	27.70	31.10	34.4	37.5	40.7	44.3	50.7

Form in which 85% Magnesia Pipe Insulation is furnished

Nominal pipe size, inches	WAUKEGAN			MANVILLE			REDWOOD CITY	
	1½″ thick incl. inner layers of Dble. Std. and 3″ thick	2″ and 2½″ thick	Outer layers of Dble. Std. and 3″	1½″ and 2″ thick, incl. inner layers of Dble. Std. and 3″	2½″ thick	Outer Layer Only	1½″, 2″ and 2½″ thick, incl. inner layers of Dble. Std. and 3″	Outer layers only of Dble. Std. and 3″
						Dble. Std. / 3″ thick		
Under 8	sect.	sect.	sect.	sectional	sectional	sectional / sectional	sectional	sectional
8	sect.	sect.	sect.	sectional	sectional	sectional / sectional	sectional	segmental
9	sect.	sect.	seg.¶	sectional	sectional	segmental¶ / segmental¶	sectional	segmental
10	sect.	sect.	seg.¶	sectional	sectional	segmental¶ / segmental¶	¶¶	segmental
11	sect.	sect.	seg.	sectional	segmental	segmental / segmental	segmental	segmental
12	seg.¶	seg.¶	seg.	segmental¶	segmental	segmental / segmental	segmental	segmental
14	seg.¶	seg.†	seg.	segmental ††	segmental	segmental / segmental	segmental	segmental
Over 14	seg.	seg.	seg.	segmental	segmental	segmental / segmental	segmental	segmental

Sect.—Furnished in sectional form, with canvas and metal bands.
Seg.—Furnished in segmental form, without canvas or bands.
¶—Can be furnished sectional, if so ordered.
¶¶—1½″ and 2″ thick are furnished sectional, 2½″ thick is furnished in two layers, each 1¼″ thick, with inner layer sectional and outer layer segmental (7 equal segments, 1 odd-width block).
†—2″ thick can be furnished sectional if so ordered.
††—1½″ thick can be furnished sectional if so ordered.

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J-M 85% Magnesia (sectional) Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot of pipe surface, per degree temperature difference, per hour.
Efficiency expressed in percent of bare pipe losses.

Insulation thickness, inches		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
Nominal pipe size ½″											
Std.	Heat Loss, B.t.u.	.788	.803	.819	.834	.850	.867	.883	.900	.916	.933
	Efficiency %	59.51	62.70	65.89	68.72	71.18	73.40	75.68	77.69	79.45	81.05
1½	Heat Loss, B.t.u.	.650	.660	.671	.681	.692	.703	.715	.726	737	.749
	Efficiency %	66.65	69.34	72.03	74.45	76.54	78.42	80.29	82.00	83.48	84.79
Dbl. Std.	Heat Loss, B.t.u.	.615	.624	.633	.643	.653	.664	.674	.685	.696	.707
	Efficiency %	68.45	71.00	73.63	75.89	77.85	79.62	81.41	83.00	84.40	85.63
2	Heat Loss, B.t.u.	.585	.594	.603	.612	.621	.631	.641	.651	.661	.671
	Efficiency %	70.00	72.40	74.89	77.05	78.95	80.64	82.33	83.87	85.19	86.36
2½	Heat Loss, B.t.u.	.540	.548	.556	.564	.573	.581	.590	.599	.608	.618
	Efficiency %	72.30	74.55	76.80	78.85	80.57	82.18	83.74	85.15	86.37	87.44
3	Heat Loss, B.t.u.	.506	.513	.521	.528	.536	.545	.553	.562	.571	.580
	Efficiency %	74.05	76.15	78.29	80.18	81.83	83.28	84.75	86.06	87.20	88.21
Nominal pipe size ¾″											
Std.	Heat Loss, B.t.u.	.714	.728	.742	.756	.771	.787	.803	.819	.835	.852
	Efficiency %	63.40	66.17	69.10	71.63	73.86	75.85	77.87	79.70	81.29	82.69
1½	Heat Loss, B.t.u.	.581	.589	.598	.608	.618	.628	.638	.649	.659	.670
	Efficiency %	70.20	72.62	75.09	77.20	79.05	80.70	82.41	83.91	85.23	86.37
Dbl. Std.	Heat Loss, B.t.u.	.547	.555	.564	.573	.583	.592	.602	.611	.621	.631
	Efficiency %	71.95	74.20	76.54	78.50	80.24	81.84	83.40	84.85	86.08	87.17
2	Heat Loss, B.t.u.	.519	.528	.536	.545	.553	.562	.570	.579	.588	.598
	Efficiency %	73.40	75.45	77.65	79.54	81.25	82.75	84.28	85.64	86.82	87.85
2½	Heat Loss, B.t.u.	.476	.483	.491	.498	.505	.513	.522	.530	.538	.547
	Efficiency %	75.56	77.55	79.54	81.32	82.87	84.26	85.60	86.85	87.94	88.89
3	Heat Loss, B.t.u.	.443	.450	.457	.464	.471	.478	.486	.493	.501	.508
	Efficiency %	77.29	79.10	80.95	82.60	84.04	85.34	86.60	87.77	88.76	89.67
Nominal pipe size 1″											
Std.	Heat Loss, B.t.u.	.652	.665	.678	.692	.706	.720	.734	.749	.764	.780
	Efficiency %	66.55	69.09	71.78	74.04	76.05	77.90	79.75	81.43	82.87	84.15
1½	Heat Loss, B.t.u.	.522	.530	.539	.548	.557	.566	.575	.584	.594	.604
	Efficiency %	73.21	75.38	77.54	79.43	81.11	82.64	84.15	85.52	86.69	87.72
Dbl. Std.	Heat Loss, B.t.u.	.489	.497	.505	.513	.521	.529	.538	.547	.555	.564
	Efficiency %	74.94	76.90	78.97	80.76	82.34	83.77	85.16	86.44	87.56	88.54
2	Heat Loss, B.t.u.	.462	.470	.478	.486	.494	.501	.509	.517	525	.533
	Efficiency %	76.33	78.15	80.10	81.76	83.25	84.63	85.96	87.19	88.24	89.16
2½	Heat Loss, B.t.u.	.421	.428	.435	.442	.449	.456	.463	.470	.477	.484
	Efficiency %	78.40	80.12	81.88	83.41	84.77	86.00	87.24	88.35	89.31	90.16
3	Heat Loss, B.t.u.	.390	.397	.403	.409	.415	.422	.428	.435	.442	.449
	Efficiency %	80.00	81.55	83.20	84.65	85.93	87.05	88.20	89.21	90.09	90.87
Nominal pipe size 1¼″											
Std.	Heat Loss, B.t.u.	.600	.613	.626	.639	.652	.665	.678	.692	.706	.721
	Efficiency %	69.20	71.50	73.90	76.03	77.90	79.60	81.30	82.84	84.16	85.34
1½	Heat Loss, B.t.u.	.472	.480	.488	.496	.504	.512	.520	.528	.537	.547
	Efficiency %	75.80	77.70	79.66	81.39	82.91	84.30	85.66	86.91	87.92	88.89
Dbl. Std.	Heat Loss, B.t.u.	.440	.448	.456	.463	.471	.478	.486	.493	.501	.509
	Efficiency %	77.44	79.20	81.00	82.64	84.04	85.34	86.60	87.77	88.76	89.65
2	Heat Loss, B.t.u.	.415	.422	.428	.435	.442	.448	.455	.463	.470	.478
	Efficiency %	78.71	80.40	82.16	83.69	85.03	86.26	87.45	88.52	89.46	90.28
2½	Heat Loss, B.t.u.	.375	.381	.387	.393	.398	.404	.410	.417	.424	.432
	Efficiency %	80.77	82.30	83.86	85.25	86.51	87.61	88.69	89.66	90.50	91.22
3	Heat Loss, B.t.u.	.346	.351	.357	.362	.367	.373	.379	.385	.391	.398
	Efficiency %	82.26	83.69	85.11	86.42	87.56	88.56	89.55	90.46	91.24	91.91
Nominal pipe size 1½″											
Std.	Heat Loss, B.t.u.	.575	.586	.598	.611	.623	.636	.650	.663	.677	.691
	Efficiency %	70.50	72.77	75.10	77.09	78.89	80.49	82.09	83.56	84.81	85.95
1½	Heat Loss, B.t.u.	.447	.454	.461	.469	.477	.485	.493	.502	.511	.519
	Efficiency %	77.09	78.90	80.77	82.40	83.83	85.12	86.40	87.56	88.55	89.45
Dbl. Std.	Heat Loss, B.t.u.	.416	.422	.428	.435	.442	.450	.457	.465	473	.482
	Efficiency %	78.68	80.39	82.16	83.69	85.02	86.20	87.40	88.47	89.40	90.20
2	Heat Loss, B.t.u.	.391	.397	.403	.410	.417	.423	.430	.437	.444	.451
	Efficiency %	79.95	81.55	83.20	84.62	85.86	87.03	88.15	89.16	90.05	90.83
2½	Heat Loss, B.t.u.	.351	.357	.362	.368	.374	.380	.386	.392	.398	.405
	Efficiency %	82.00	83.41	84.91	86.19	87.32	88.34	89.36	90.29	91.08	91.77
3	Heat Loss, B.t.u.	.324	.329	.334	.339	.345	.350	.356	.362	.368	.373
	Efficiency %	83.38	84.71	86.09	87.29	88.30	89.27	90.19	91.04	91.75	92.42
Nominal pipe size 2″											
Std.	Heat Loss, B.t.u.	.496	.506	.516	.526	.536	.547	.557	.568	.579	.590
	Efficiency %	74.55	76.49	78.50	80.27	81.83	83.22	84.64	85.92	87.02	88.01
1½	Heat Loss, B.t.u.	.412	.419	.427	.434	.442	.449	.457	.464	.472	.479
	Efficiency %	78.88	80.54	82.21	83.72	85.02	86.22	87.40	88.50	89.42	90.26
2	Heat Loss, B.t.u.	.356	.362	.367	.373	.379	.385	.392	.398	.405	.412
	Efficiency %	81.74	83.17	84.71	86.00	87.16	88.19	89.19	90.14	90.92	91.63
Dbl. Std.	Heat Loss, B.t.u.	.352	.357	.363	.368	.373	.379	.385	.391	.398	.405
	Efficiency %	81.95	83.41	84.87	86.19	87.35	88.36	89.39	90.31	91.08	91.77
2½	Heat Loss, B.t.u.	.318	.323	.328	.333	.338	.344	.350	.356	.362	.367
	Efficiency %	83.69	84.99	86.33	87.50	88.55	89.45	90.35	91.18	91.89	92.54
3	Heat Loss, B.t.u.	.292	.296	.301	.306	.311	.315	.320	.325	.330	.335
	Efficiency %	85.02	86.25	87.46	88.51	89.46	90.33	91.18	91.94	92.60	93.19
Nominal pipe size 2½″											
Std.	Heat Loss, B.t.u.	.470	.480	.490	.500	.510	.520	.530	.540	.551	.562
	Efficiency %....	75.90	77.70	79.58	81.24	82.71	84.05	85.39	86.61	87.65	88.57
1½	Heat Loss, B.t.u.	.381	.389	.397	.404	.412	.420	.428	.435	.443	.451
	Efficiency %....	80.46	81.92	83.45	84.85	86.04	87.11	88.20	89.21	90.07	90.83
2	Heat Loss, B.t.u.	.332	.337	.342	.348	.353	.358	.364	.370	.376	.382
	Efficiency %....	82.98	84.34	85.75	86.94	88.04	89.01	89.96	90.83	91.57	92.24
Dbl. Std.	Heat Loss, B.t.u.	.327	.332	.337	.342	.348	.353	.358	.364	.370	.376
	Efficiency %....	83.24	84.57	85.95	87.16	88.20	89.16	90.13	90.98	91.71	92.36
2½	Heat Loss, B.t.u.	.293	.298	.303	.308	.313	.319	.324	.330	.335	.340
	Efficiency %....	84.98	86.15	87.36	88.44	89.39	90.21	91.06	91.82	92.49	93.09
3	Heat Loss, B.t.u.	.269	.273	.277	.281	.285	.290	.294	.299	.304	.309
	Efficiency %....	86.21	87.30	88.45	89.46	90.34	91.10	91.89	92.60	93.19	93.72

Insulation thickness, inches		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375	425	475	525	575
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300	350	400	450	500
Nominal pipe size 3″											
Std.	Heat Loss, B.t.u.	.448	.458	.467	.477	.487	.497	.507	.517	.527	.537
	Efficiency %	77.02	78.70	80.54	82.10	83.49	84.75	86.02	87.19	88.19	89.09
1½	Heat Loss, B.t.u.	.364	.370	.377	.383	.390	.397	.403	.410	.418	.425
	Efficiency %	81.34	82.80	84.29	85.63	86.79	87.81	88.89	89.84	90.64	91.36
Dbl. Std.	Heat Loss, B.t.u.	.303	.309	.314	.319	.325	.330	.335	.341	.347	.352
	Efficiency %	84.46	85.64	86.92	88.03	88.98	89.87	90.76	91.54	92.22	92.84
2	Heat Loss, B.t.u.	.310	.315	.320	.326	.331	.337	.342	.348	.353	.359
	Efficiency %	84.10	85.35	86.66	87.77	88.78	89.66	90.56	91.37	92.09	92.70
2½	Heat Loss, B.t.u.	.274	.278	.283	.287	.292	.296	.301	.306	.311	.316
	Efficiency %	85.95	87.08	88.20	89.24	90.10	90.92	91.70	92.41	93.03	93.58
3	Heat Loss, B.t.u.	.248	.252	.256	.260	.264	.268	.272	.276	.280	.285
	Efficiency %	87.29	88.29	89.33	90.25	91.05	91.78	92.50	93.16	93.72	94.21
Nominal pipe size 3½″											
Std.	Heat Loss, B.t.u.	.435	.444	.453	.462	.472	.481	.491	.501	.511	.521
	Efficiency %	77.70	79.35	81.12	82.66	84.00	85.24	86.46	87.58	88.55	89.41
1½	Heat Loss, B.t.u.	.350	.356	.363	.369	.376	.382	.389	.396	.403	.410
	Efficiency %	82.05	83.44	84.87	86.15	87.26	88.28	89.27	90.18	90.96	91.66
Dbl. Std.	Heat Loss, B.t.u.	.289	.294	.298	.303	.308	.313	.318	.324	.330	.336
	Efficiency %	85.19	86.33	87.58	88.63	89.56	90.40	91.24	91.96	92.60	93.18
2	Heat Loss, B.t.u.	.297	.302	.307	.312	.317	.322	.327	.333	.338	.343
	Efficiency %	84.77	85.96	87.20	88.29	89.26	90.12	90.99	91.74	92.42	93.03
2½	Heat Loss, B.t.u.	.258	.263	.268	.272	.277	.282	.287	.292	.298	.303
	Efficiency %	86.76	87.76	88.83	89.80	90.61	91.35	92.09	92.76	93.32	93.84
3	Heat Loss, B.t.u.	.236	.240	.244	.247	.251	.255	.259	.263	.267	.271
	Efficiency %	87.90	88.84	89.83	90.75	91.49	92.18	92.86	93.48	94.04	94.49
Nominal pipe size 4″											
Std.	Heat Loss, B.t.u.	.403	.411	.419	.427	.436	.444	.453	.462	.471	.479
	Efficiency %	79.31	80.90	82.54	83.99	85.22	86.36	87.50	88.55	89.44	90.26
1½	Heat Loss, B.t.u.	.340	.346	.352	.358	.365	.371	.378	.385	.392	.399
	Efficiency %	82.58	83.91	85.34	86.55	87.62	88.60	89.58	90.46	91.21	91.89
Dbl. Std.	Heat Loss, B.t.u.	.269	.273	.278	.282	.286	.290	.295	.300	.305	.310
	Efficiency %	86.20	87.30	88.42	89.41	90.30	91.10	91.87	92.55	93.16	93.70
2	Heat Loss, B.t.u.	.286	.291	.296	.301	.306	.311	.316	.321	.326	.331
	Efficiency %	85.34	86.50	87.65	88.71	89.63	90.46	91.29	92.03	92.69	93.28
2½	Heat Loss, B.t.u.	.252	.256	.260	.264	.268	.272	.277	.281	.286	.290
	Efficiency %	87.09	88.09	89.16	90.19	90.91	91.66	92.36	93.04	93.59	94.11
3	Heat Loss, B.t.u.	.227	.230	.233	.236	.240	.244	.248	.252	.256	.260
	Efficiency %	88.35	89.30	90.29	91.15	91.87	92.52	93.16	93.75	94.26	94.71
Nominal pipe size 4½″											
Std.	Heat Loss, B.t.u.	.395	.403	.411	.419	.428	.436	.444	.453	.462	.472
	Efficiency %	79.74	81.25	82.86	84.29	85.49	86.63	87.75	88.76	89.65	90.41
1½	Heat Loss, B.t.u.	.332	.338	.344	.350	.356	.362	.368	.375	.382	.389
	Efficiency %	82.98	84.29	85.65	86.89	87.94	88.90	89.85	90.70	91.44	92.10
Dbl. Std.	Heat Loss, B.t.u.	.259	.263	.268	.273	.277	.282	.287	.291	.296	.301
	Efficiency %	86.71	87.76	88.83	89.75	90.61	91.35	92.09	92.78	93.36	93.88
2	Heat Loss, B.t.u.	.278	.283	.288	.292	.297	.302	.307	.313	.318	.323
	Efficiency %	85.75	86.84	88.00	89.05	89.94	90.75	91.54	92.24	92.88	93.44
2½	Heat Loss, B.t.u.	.243	.247	.251	.255	.259	.263	.267	.272	.276	.280
	Efficiency %	87.54	88.50	89.54	90.45	91.22	91.94	92.64	93.26	93.82	94.31
3	Heat Loss, B.t.u.	.218	.222	.226	.229	.233	.236	.240	.244	.248	.252
	Efficiency %	88.81	89.69	90.59	91.40	92.11	92.75	93.38	93.95	94.44	94.88
Nominal pipe size 5″											
Std.	Heat Loss, B.t.u.	.385	.393	.401	.411	.418	.426	.434	.443	.452	.460
	Efficiency %	80.25	81.73	83.29	84.58	85.84	86.94	88.04	89.02	89.86	90.65
1½	Heat Loss, B.t.u.	.324	.329	.336	.342	.349	.355	.362	.368	.374	.381
	Efficiency %	83.38	84.71	86.00	87.16	88.16	89.11	90.02	90.88	91.62	92.25
Dbl. Std.	Heat Loss, B.t.u.	.253	.257	.262	.266	.271	.275	.280	.284	.289	.293
	Efficiency %	87.03	88.05	89.09	90.02	90.81	91.56	92.28	92.96	93.52	94.04
2	Heat Loss, B.t.u.	.272	.277	.282	.286	.291	.296	.300	.305	.310	.315
	Efficiency %	86.05	87.11	88.25	89.27	90.14	90.92	91.73	92.44	93.06	93.60
2½	Heat Loss, B.t.u.	.237	.241	.245	.249	.253	.257	.261	.265	.270	.274
	Efficiency %	87.85	88.80	89.79	90.65	91.41	92.12	92.80	93.42	93.95	94.43
3	Heat Loss, B.t.u.	.211	.215	.218	.221	.225	.228	.232	.235	.239	.243
	Efficiency %	89.17	90.00	90.91	91.71	92.37	93.01	93.60	94.17	94.64	95.06
Nominal pipe size 6″											
Std.	Heat Loss, B.t.u.	.373	.382	.390	.399	.407	.415	.424	.432	.440	.449
	Efficiency %	80.86	82.24	83.75	85.01	86.21	87.26	88.30	89.29	90.14	90.87
1½	Heat Loss, B.t.u.	.314	.319	.325	.330	.336	.342	.348	.354	.361	.367
	Efficiency %	83.89	85.16	86.45	87.61	88.60	89.51	90.40	91.22	91.90	92.54
2	Heat Loss, B.t.u.	.261	.265	.269	.273	.278	.282	.287	.292	.297	.302
	Efficiency %	86.61	87.68	88.79	89.75	90.57	91.35	92.09	92.76	93.34	93.87
Dbl. Std.	Heat Loss, B.t.u.	.241	.245	.249	.253	.257	.261	.265	.269	.274	.279
	Efficiency %	87.64	88.61	89.61	90.50	91.29	92.00	92.70	93.32	93.86	94.34
2½	Heat Loss, B.t.u.	.225	.229	.232	.236	.240	.244	.248	.252	.256	.261
	Efficiency %	88.45	89.35	90.34	91.15	91.87	92.52	93.16	93.75	94.26	94.69
3	Heat Loss, B.t.u.	.201	.204	.207	.210	.213	.217	.220	.224	.227	.231
	Efficiency %	89.69	90.50	91.37	92.11	92.78	93.35	93.94	94.45	94.91	95.30
Nominal pipe size 7″											
Std.	Heat Loss, B.t.u.	.340	.347	.354	.361	.368	.375	.388	.390	.398	.405
	Efficiency %	82.55	83.88	85.25	86.45	87.52	88.49	89.44	90.34	91.08	91.77
1½	Heat Loss, B.t.u.	.307	.312	.317	.322	.328	.334	.340	.346	.352	.359
	Efficiency %	84.25	85.50	86.79	87.91	88.88	89.75	90.62	91.40	92.11	92.70
2	Heat Loss, B.t.u.	.252	.257	.261	.265	.270	.274	.278	.283	.288	.293
	Efficiency %	87.08	88.05	89.13	90.06	90.85	91.60	92.34	92.97	93.54	94.04
2½	Heat Loss, B.t.u.	.218	.221	.224	.228	.231	.235	.239	.243	.247	.251
	Efficiency %	88.81	89.70	90.66	91.45	92.17	92.79	93.41	93.98	94.46	94.90
3	Heat Loss, B.t.u.	—	—	—	—	—	—	—	—	—	—
	Efficiency %	—	—	—	—	—	—	—	—	—	—
	Heat Loss, B.t.u.	.193	.196	.199	.202	.205	.209	.212	.215	.219	.223
	Efficiency %	90.10	90.89	91.70	92.42	93.06	93.60	94.16	94.66	95.09	95.47

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J-M 85% MAGNESIA (SECTIONAL) HEAT LOSSES AND EFFICIENCIES *(continued)*

Heat losses expressed in B.t.u. per square foot of pipe surface, per degree temperature difference, per hour.
Efficiency expressed in percent of bare pipe losses.

Insulation thickness, inches		Temperature of pipe—deg. Fahr. / Temperature difference between pipe and air—deg. Fahr.									
		125 / 50	175 / 100	225 / 150	275 / 200	325 / 250	375 / 300	425 / 350	475 / 400	525 / 450	575 / 500
Nominal pipe size 8″											
Std.	Heat Loss, B.t.u.	.336	.343	.351	.357	.364	.371	.378	.386	.393	.401
	Efficiency %	86.76	84.05	85.41	86.60	87.66	88.60	89.57	90.41	91.19	91.85
1½	Heat Loss, B.t.u.	.298	.303	.308	.314	.320	.326	.332	.338	.345	.351
	Efficiency %	84.71	85.91	87.16	88.22	89.15	90.00	90.85	91.62	92.26	92.87
2	Heat Loss, B.t.u.	.246	.250	.254	.258	.262	.267	.272	.276	.281	.286
	Efficiency %	87.38	88.39	89.41	90.32	91.12	91.81	92.50	93.16	93.70	94.19
Dbl. Std.	Heat Loss, B.t.u.	.212	.215	.218	.222	.226	.229	.233	.237	.241	.245
	Efficiency %	89.12	90.00	90.91	91.66	92.34	92.97	93.57	94.12	94.59	95.02
3	Heat Loss, B.t.u.	.187	.190	.193	.196	.199	.202	.205	.208	.211	.215
	Efficiency %	90.41	91.16	91.95	92.65	93.26	93.80	94.35	94.84	95.27	95.64
Nominal pipe size 9″											
Std.	Heat Loss, B.t.u.	.331	.338	.345	.352	.359	.366	.373	.380	.387	.394
	Efficiency %	83.02	84.29	85.62	86.80	87.82	88.79	89.72	90.59	91.32	91.99
1½	Heat Loss, B.t.u.	.295	.300	.306	.311	.317	.322	.328	.334	.340	.346
	Efficiency %	84.86	86.05	87.25	88.32	89.25	90.15	90.96	91.72	92.38	92.96
2	Heat Loss, B.t.u.	.242	.246	.250	.254	.258	.263	.267	.271	.276	.281
	Efficiency %	87.59	88.55	89.59	90.46	91.29	91.94	92.64	93.28	93.82	94.29
Dbl. Std.	Heat Loss, B.t.u.	.207	.210	.213	.217	.220	.224	.228	.231	.235	.239
	Efficiency %	89.38	90.24	91.13	91.86	92.55	93.14	93.72	94.27	94.73	95.14
3	Heat Loss, B.t.u.	.184	.186	.189	.192	.195	.198	.201	.204	.207	.210
	Efficiency %	90.56	91.35	92.12	92.80	93.39	93.92	94.46	94.94	95.36	95.73
Nominal pipe size 10″											
Std.	Heat Loss, B.t.u.	.327	.334	.341	.348	.355	.362	.369	.376	.383	.390
	Efficiency %	83.23	84.46	85.79	86.94	87.96	88.90	89.82	90.69	91.41	92.08
1½	Heat Loss, B.t.u.	.290	.295	.300	.306	.311	.317	.323	.328	.334	.340
	Efficiency %	85.12	86.30	87.50	88.52	89.46	90.28	91.10	91.87	92.53	93.09
2	Heat Loss, B.t.u.	.237	.241	.245	.249	.253	.257	.261	.265	.270	.275
	Efficiency %	87.84	88.80	89.79	90.65	91.44	92.12	92.80	93.42	93.95	94.41
Dbl. Std.	Heat Loss, B.t.u.	.203	.206	.210	.213	.216	.220	.223	.227	.230	.234
	Efficiency %	89.59	90.42	91.25	92.01	92.68	93.26	93.86	94.38	94.84	95.24
3	Heat Loss, B.t.u.	.178	.181	.184	.187	.190	.193	.196	.199	.202	.205
	Efficiency %	90.87	91.59	92.34	92.99	93.56	94.08	94.60	95.07	95.47	95.84
Nominal pipe size 12″											
Std.	Heat Loss, B.t.u.	.284	.289	.295	.300	.306	.311	.317	.323	.328	.334
	Efficiency %	85.44	86.56	87.70	88.75	89.63	90.46	91.26	92.00	92.65	93.21
2	Heat Loss, B.t.u.	.231	.235	.239	.243	.247	.251	.255	.259	.264	.269
	Efficiency %	88.15	89.05	90.04	90.89	91.64	92.30	92.97	93.58	94.08	94.53
2½	Heat Loss, B.t.u.	.197	.200	.203	.206	.209	.213	.216	.219	.223	.227
	Efficiency %	89.90	90.70	91.54	92.27	92.92	93.47	94.04	94.58	95.00	95.39
Dbl. Std.	Heat Loss, B.t.u.	.172	.175	.178	.181	.184	.187	.190	.193	.196	.199
	Efficiency %	91.18	91.87	92.58	93.21	93.76	94.26	94.76	95.22	95.61	95.95
Nominal pipe size 14″											
Std.	Heat Loss, B.t.u.	.281	.286	.292	.297	.302	.308	.313	.319	.325	.330
	Efficiency %	85.59	86.70	87.84	88.85	89.76	90.55	91.36	92.09	92.72	93.29
2	Heat Loss, B.t.u.	.228	.232	.236	.240	.244	.248	.252	.256	.260	.265
	Efficiency %	88.30	89.21	90.16	91.00	91.74	92.39	93.05	93.65	94.17	94.61
2½	Heat Loss, B.t.u.	.194	.197	.200	.203	.206	.209	.213	.216	.220	.224
	Efficiency %	90.05	90.85	91.66	92.38	93.02	93.59	94.13	94.64	95.07	95.44
Dbl. Std.	Heat Loss, B.t.u.	.169	.172	.175	.177	.180	.183	.186	.189	.192	.195
	Efficiency %	91.34	92.00	92.71	93.36	93.90	94.40	94.87	95.31	95.70	96.04
Nominal pipe size 16″											
Std.	Heat Loss, B.t.u.	.278	.283	.288	.293	.298	.303	.309	.315	.320	.326
	Efficiency %	85.75	86.84	88.00	89.00	89.90	90.70	91.49	92.18	92.82	93.38
2	Heat Loss, B.t.u.	.224	.228	.232	.236	.240	.244	.248	.252	.256	.260
	Efficiency %	88.51	89.40	90.34	91.15	91.87	92.52	93.16	93.75	94.26	94.71
2½	Heat Loss, B.t.u.	.189	.192	.195	.199	.202	.205	.209	.212	.215	.219
	Efficiency %	90.31	91.07	91.88	92.54	93.16	93.71	94.24	94.74	95.18	95.54
Dbl. Std.	Heat Loss, B.t.u.	.165	.168	.171	.174	.176	.179	.182	.185	.188	.191
	Efficiency %	91.54	92.19	92.88	93.47	94.04	94.51	94.98	95.41	95.78	96.12
Nominal pipe size 18″											
Std.	Heat Loss, B.t.u.	.275	.280	.285	.290	.296	.301	.306	.311	.316	.322
	Efficiency %	85.90	86.97	88.12	89.11	89.97	90.76	91.57	92.28	92.92	93.46
2	Heat Loss, B.t.u.	.222	.226	.230	.234	.238	.242	.246	.250	.254	.258
	Efficiency %	88.61	89.49	90.42	91.22	91.94	92.58	93.22	93.80	94.31	94.76
Dbl. Std.	Heat Loss, B.t.u.	.186	.190	.193	.196	.200	.203	.206	.210	.213	.217
	Efficiency %	90.46	91.16	91.96	92.65	93.22	93.78	94.32	94.79	95.22	95.59
3	Heat Loss, B.t.u.	.162	.165	.167	.170	.173	.175	.178	.181	.184	.187
	Efficiency %	91.69	92.33	93.04	93.60	94.14	94.63	95.09	95.51	95.88	96.20

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Superex Pipe Insulation

For temperatures to 1900 deg. F.

Superex is the most adaptable material for insulating surfaces where the material applied must resist temperatures between 600 and 1900 deg. F.

In the manufacture of Superex, specially selected and calcined diatomaceous silica is blended together with asbestos fibre. This combination produces a material of high heat resistance and exceptional insulating value.

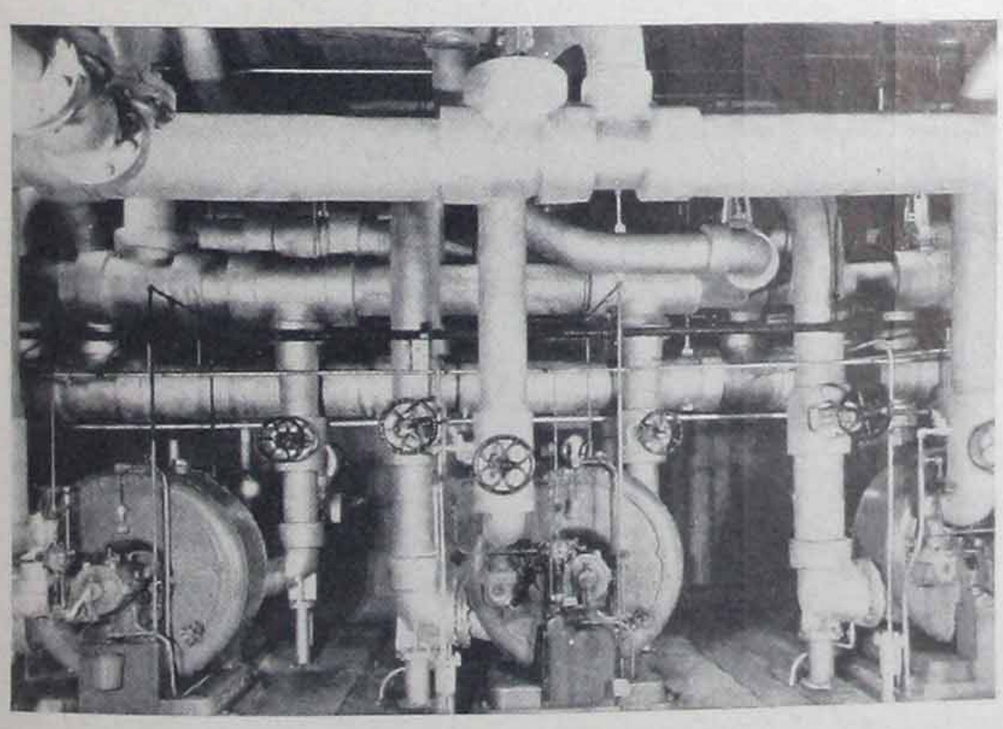
It has a low thermal conductivity, which is maintained in service. It will safely withstand temperatures up to 1900 deg. F. and, although weighing only about 23 lb. per cu. ft., possesses ample strength.

Superex Insulation is supplied, to fit standard pipe sizes, in sections or segments, 3 ft. long and up to 3″ thick. The 3″ thickness is furnished in two layers. Smaller pipe sizes are furnished sectional. Larger sizes are supplied sectional or segmental as shown in lower table on reverse. Canvas and bands are supplied with insulation for pipe sizes 1½″ and smaller.

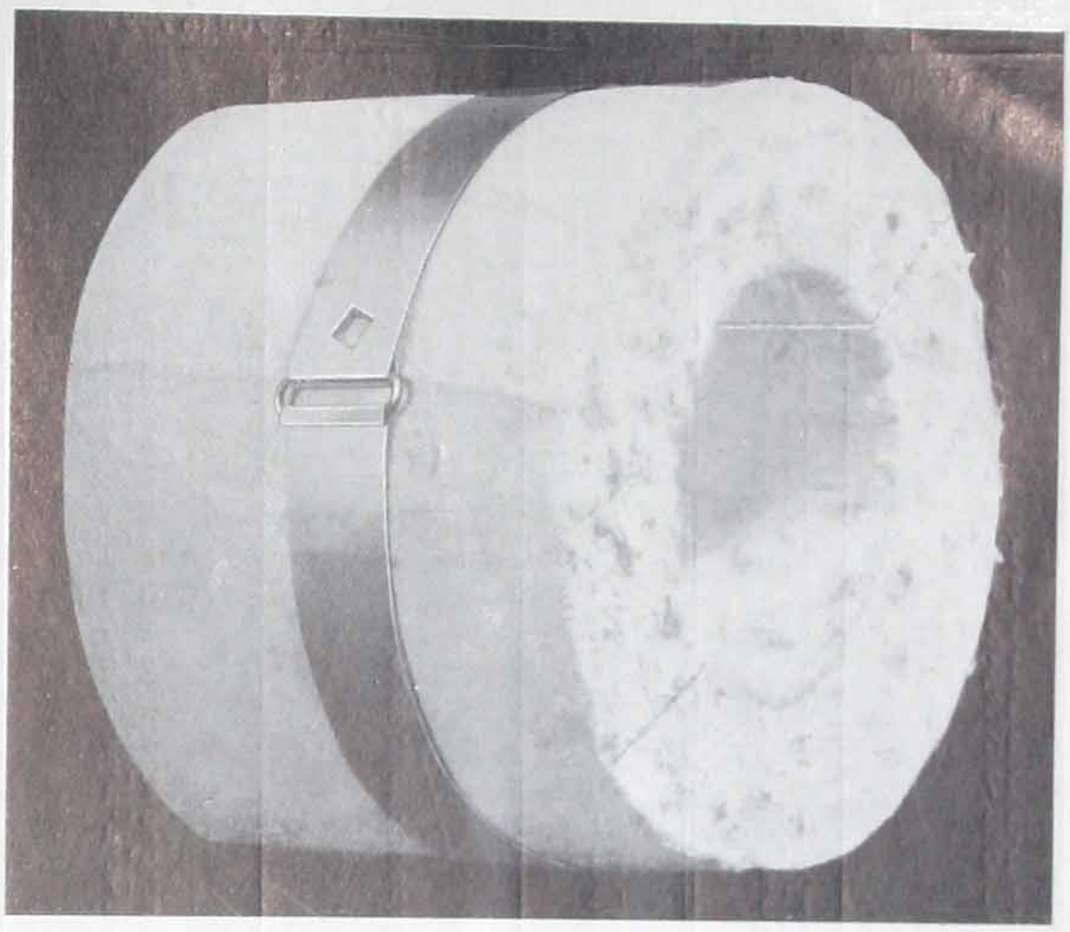
Superex is also furnished in block form as described in another data sheet.

Superex Combination Insulation

Superex Insulation is often used as an inner layer in combination with other Johns-Manville materials, such as 85% Magnesia or Asbesto-Sponge Felted, to combine the greater insulation efficiency of these materials with the high heat resistance of Superex. In this construction, Superex is used as protection for the other insulation which, although high in insulating value, is comparatively low in heat resistance.



Superex Combination Pipe Insulation at Avon Station of Cleveland Electric Illuminating Co.



Recommended Thicknesses:

Tables A and B, on the reverse, give J-M standard recommendations for the use of Superex Insulation as a protective inner layer for 85% Magnesia or Asbesto-Sponge Felted insulation, when the combination is used for temperatures up to 1000 deg. F.

It is to be noted that only the recommended thicknesses of 85% Magnesia and Asbesto-Sponge Felted are listed in the tables. For the pipe sizes mentioned, Asbesto-Sponge Felted is available from 1″ to 3″ thick and Magnesia, in the following thicknesses: Standard, 1½″, 2″, 2½″, Double Standard and 3″ (double layer).

Instructions for ordering:

When Superex Combination Insulation is ordered, the following information should be given:

1. Superex Combination Insulation, Table A or B
2. Quantity, pipe size and thickness of Superex
3. Quantity, pipe size, thickness and material (85% Magnesia or Asbesto-Sponge Felted) to be used for the outer layer.

For example:

To order 300 ft. of Superex Combination Insulation for 8″ pipe, consisting of 1½″ Superex Insulation over which is to be applied 2″ thick 85% Magnesia (for temperatures from 600 to 699 deg. F.), the order should read: "Superex Combination Insulation, Table A; 300 ft. Superex, 8″ pipe size, 1½″ thick; 300 ft. 85% Magnesia, 11″ pipe size, 2″ thick."

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Recommended Thicknesses for Superex Combination Pipe Insulation

Table A—Temperatures 600 to 799 deg. F.

Inner Layer: Superex		Outer Layer: 85% Magnesia or Asbesto-Sponge Felted		
Nominal pipe size, inches	Approximate thickness, inches	Nominal pipe size, inches	Recommended thickness, inches: 600 to 699 deg. F.	Recommended thickness, inches: 700 to 799 deg. F.
1½ or less	2	No outer layer	—	—
2	1¼	4½	1½	2
2½	1 5/16	5	1½	2
3	1 9/16	6	1½	2
3½	1 5/16	6	1½	2
4	1 9/16	7	1½	2
4½	1 5/16	7	2	2½
5	1½	8	2	2½
6	1½	9	2	2½
7	1½	10	2	2½
8	1½	11	2	2½
9	1½	12	2	2½
10	1 9/16	14	2	2½
11	1 9/16	15	2	2½
12	1 9/16	16	2	2½
14	1½	17	2	2½
15	1½	18	2	2½
16	1½	19	2	2½
17	1½	20	2	2½
18	1½	21	2	2½
19	1½	22	2	2½
20	1½	23	2	2½
21	1½	24	2	2½
22	1½	26	2	2½
23	1½	26	2	2½
24	1½	27	2	2½
26	1½	30	2	2½
27	1½	30	2	2½
28	1½	32	2	2½
30	1½	33	2	2½
32	1½	35	2	2½
33	1½	36	2	2½

Table B—Temperatures 800 to 1000 deg. F.

Inner Layer: Superex		Outer Layer: 85% Magnesia or Asbesto-Sponge Felted	
Nominal pipe size, inches	Approximate thickness, inches	Nominal pipe size, inches	Recommended thickness, inches
1½ or less	2	No outer layer	—
2	2⅛	6	1½
2½	1 13/16	6	1½
3	2 1/16	7	1½
3½	1 13/16	7	1½
4	2 1/16	8	1½
4½	1 13/16	8	2
5	2	9	2
6	2 1/16	10	2
7	2	11	2
8	2	12	2
9	2⅛	14	2
10	2⅛	15	2
11	2⅛	16	2
12	2⅛	17	2
14	2	18	2
15	2	19	2
16	2	20	2
17	2	21	2
18	2	22	2
19	2	23	2
20	2	24	2
21	2	26	2
22	2	26	2
23	2	27	2
24	2	28	2
26	2	30	2
27	2	32	2
28	2	32	2
30	2	34	2
32	2	36	2
33	2	37	2

Number of Segments for Magnesia and Superex

Nominal Pipe Size, Inches	WAUKEGAN		MANVILLE						REDWOOD CITY			
	1½", 2" and 2½" Thick, including Inner Layers of Dble. Std. and 3"	Outer Layers Only of Dble. Std. and 3"	1½" and 2" Thick, including Inner Layers of Dble. Std. and 3"		2½" Thick		Outer Layers Only of Dble. Std. and 3"		1½", 2" and 2½" Thick, including Inner Layers of Dble. Std. and 3"		Outer Layers Only of Dble. Std. and 3"	
			Equal	Odd	Equal	Odd	Equal	Odd	Equal	Odd	Equal	Odd
8	sect.	sect.	sect.	sect.	sect.	sect.	sect.	sect.	sect.	sect.	6	1
9	sect.	8¶	sect.	sect.	sect.	sect.	sect.**	sect.**	sect.	sect.	7	none
10	sect.	8¶	sect.	sect.	sect.	sect.	8¶	1	¶¶	¶¶	7	1
11	sect.	9	sect.	sect.	7	1	9	none	6	1	8	1
12	8¶	9	8¶	none	8	none	10	none	7	none	9	none
14	8†	10	8††	1	8	1	10	1	7	1	9	1
15	9	11	9	1	9	1	11	1	8	1	10	none
16	9	11	10	none	10	none	12	none	9	none	10	1
17	10	12	10	1	10	1	12	1	9	1	11	none
18	11	12	11	1	11	1	13	1	10	none	11	1
19	11	13	12	none	12	none	13	1	10	1	12	none
20	12	13	12	1	12	1	14	1	11	none	12	1
21	12	14	13	1	13	1	15	none	11	1	13	none
22	13	14	13	1	13	1	15	1	12	none	13	1
23	13	14	14	1	14	1	16	1	12	1	14	none
24	14	14	15	none	15	none	17	none	13	none	14	1
26	14	15	16	1	16	1	18	1	14	none	15	1
27	14	16	17	none	17	none	19*	none	14	1	16	1
28	15	16	17	1	17	1	16	1	15	1	16	1
30	16	17	19*	none	19*	none	17	1	16	1	18	1
32	17	19	16	1	16	1	18	1	17	1	19	1
33	17	20	17	1	17	1	18	1	18	1	20	1

Sect.—Furnished in sectional form in crates or cartons, with metal bands.
¶—Can be furnished sectional, if so ordered.
¶¶—1½" and 2" thick are furnished sectional, 2½" thick is furnished in two layers, each 1¼" thick, with inner layer sectional and outer layer segmental (7 equal segments, 1 odd-width block).
†—1½" and 2" thick can be furnished sectional if so ordered.
††—1½" thick can be furnished sectional if so ordered.
*Also furnished in wider segments (15 equal and 1 odd-width block).
**Furnished segmental if so ordered (Dble. Std., 7 equal and 1 odd-width segment; 3" Thick, 8 equal segments).

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Superex Combination Insulation (with 85% Magnesia) Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot of pipe surface, per degree temperature difference, per hour.
Efficiency expressed as a percentage of bare pipe losses.

Thickness of Superex insulation, inches	Pipe size of 85% Magnesia, inches	Thickness of 85% Magnesia, inches	Total thickness of insulation, inches		Temperature of pipe—deg. Fahr. 500	600	700	800
					Temperature difference, pipe to air—deg. Fahr. 425	525	625	725
				Nominal pipe size 1/2"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.840	.856	.872	.888
				Efficiency %	80.23	83.37	85.67	87.38
2	No outer layer		2	Heat Loss, B.t.u.	.755	.767	.779	.793
				Efficiency %	82.23	85.09	87.20	88.73
				Nominal pipe size 3/4"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.752	.767	.782	.797
				Efficiency %	82.30	85.09	87.15	88.68
2	No outer layer		2	Heat Loss, B.t.u.	.670	.680	.692	.704
				Efficiency %	84.23	86.78	88.63	90.00
				Nominal pipe size 1"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.678	.691	.705	.719
				Efficiency %	84.04	86.57	88.42	89.78
2	No outer layer		2	Heat Loss, B.t.u.	.598	.608	.619	.630
				Efficiency %	85.92	88.18	89.83	91.05
				Nominal pipe size 1¼"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.612	.625	.638	.651
				Efficiency %	85.59	87.85	89.52	90.75
2	No outer layer		2	Heat Loss, B.t.u.	.536	.545	.555	.565
				Efficiency %	87.38	89.41	90.88	91.97
				Nominal pipe size 1½"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.581	.593	.605	.617
				Efficiency %	86.32	88.48	90.06	91.23
2	No outer layer		2	Heat Loss, B.t.u.	.506	.515	.524	.533
				Efficiency %	88.09	89.99	91.39	92.43
				Nominal pipe size 2"				
1¼	4½	1½	2¾	Heat Loss, B.t.u.	.358	.366	.375	.385
				Efficiency %	91.57	92.90	93.84	94.52
		2	3¼	Heat Loss, B.t.u.	.327	.335	.343	.352
				Efficiency %	92.30	93.50	94.36	95.00
		Dbl. Std.	3½	Heat Loss, B.t.u.	.314	.322	.330	.338
				Efficiency %	92.61	93.75	94.58	95.20
		2½	3¾	Heat Loss, B.t.u.	.303	.311	.319	.327
				Efficiency %	92.86	93.96	94.76	95.35
		3	4¼	Heat Loss, B.t.u.	.286	.293	.300	.303
				Efficiency %	93.26	94.31	95.07	95.62
				Nominal pipe size 2½"				
1 5/16	5	1½	2 5/16	Heat Loss, B.t.u.	.327	.335	.343	.352
				Efficiency %	92.30	93.50	94.36	95.00
		2	3 5/16	Heat Loss, B.t.u.	.297	.304	.312	.321
				Efficiency %	93.01	94.10	94.87	95.43
		Dbl. Std.	3 5/16	Heat Loss, B.t.u.	.286	.293	.300	.308
				Efficiency %	93.26	94.31	95.07	95.62
		2½	3 5/16	Heat Loss, B.t.u.	.276	.282	.289	.297
				Efficiency %	93.50	94.52	95.25	95.78
		3	4 5/16	Heat Loss, B.t.u.	.259	.265	.272	.280
				Efficiency %	93.90	94.86	95.53	96.02
				Nominal pipe size 3"				
1 5/16	6	1½	3 1/16	Heat Loss, B.t.u.	.289	.296	.303	.311
				Efficiency %	93.20	94.26	95.01	95.56
		2	3 5/16	Heat Loss, B.t.u.	.264	.270	.277	.285
				Efficiency %	93.78	94.76	95.45	95.94
		Dbl. Std.	3 13/16	Heat Loss, B.t.u.	.254	.260	.267	.275
				Efficiency %	94.02	94.96	95.61	96.09
		2½	4 1/16	Heat Loss, B.t.u.	.244	.250	.257	.265
				Efficiency %	94.26	95.15	95.77	96.24
		3	4 5/16	Heat Loss, B.t.u.	.229	.235	.241	.248
				Efficiency %	94.61	95.44	96.04	96.48
				Nominal pipe size 3½"				
1 5/16	6	1½	2 5/16	Heat Loss, B.t.u.	.287	.294	.301	.309
				Efficiency %	93.24	94.30	95.05	95.60
		2	3 5/16	Heat Loss, B.t.u.	.259	.265	.272	.280
				Efficiency %	93.90	94.86	95.53	96.02
		Dbl. Std.	3 5/16	Heat Loss, B.t.u.	.249	.255	.261	.268
				Efficiency %	94.14	95.05	95.71	96.19
		2½	3 5/16	Heat Loss, B.t.u.	.238	.244	.250	.257
				Efficiency %	94.40	95.27	95.90	96.35
		3	4 5/16	Heat Loss, B.t.u.	.223	.228	.234	.241
				Efficiency %	94.74	95.58	96.16	96.58
				Nominal pipe size 4"				
1 5/16	7	1½	3 1/16	Heat Loss, B.t.u.	.263	.269	.276	.284
				Efficiency %	93.81	94.78	95.47	95.96
		2	3 5/16	Heat Loss, B.t.u.	.240	.245	.251	.258
				Efficiency %	94.35	95.25	95.88	96.33
		2½	4 1/16	Heat Loss, B.t.u.	.221	.226	.232	.239
				Efficiency %	94.80	95.62	96.19	96.60
		3	4 5/16	Heat Loss, B.t.u.	.206	.211	.217	.223
				Efficiency %	95.15	95.90	96.43	96.83
				Nominal pipe size 4½"				
1 5/16	7	2	3 5/16	Heat Loss, B.t.u.	.239	.245	.252	.259
				Efficiency %	94.38	95.25	95.86	96.31
		2½	3 5/16	Heat Loss, B.t.u.	.218	.224	.230	.237
				Efficiency %	94.87	95.65	96.23	96.64
		3	4 5/16	Heat Loss, B.t.u.	.204	.208	.213	.219
				Efficiency %	95.20	95.96	96.50	96.89

Thickness of Superex insulation, inches	Pipe size of 85% Magnesia, inches	Thickness of 85% Magnesia, inches	Total thickness of insulation, inches		Temperature of pipe—deg. Fahr. 500	600	700	800
					Temperature difference, pipe to air—deg. Fahr. 425	525	625	725
				Nominal pipe size 5"				
1½	8	2	3½	Heat Loss, B.t.u.	.223	.229	.235	.242
				Efficiency %	94.74	95.56	96.14	96.57
		2½	4	Heat Loss, B.t.u.	.205	.210	.215	.222
				Efficiency %	95.17	95.92	96.47	96.84
		3	4½	Heat Loss, B.t.u.	.190	.195	.200	.206
				Efficiency %	95.52	96.22	96.72	97.07
				Nominal pipe size 6"				
1½	9	2	3½	Heat Loss, B.t.u.	.211	.217	.223	.230
				Efficiency %	95.03	95.79	96.34	96.73
		2½	4	Heat Loss, B.t.u.	.194	.199	.204	.210
				Efficiency %	95.43	96.14	96.64	97.01
		3	4½	Heat Loss, B.t.u.	.179	.184	.189	.195
				Efficiency %	95.79	96.43	96.90	97.23
				Nominal pipe size 7"				
1½	10	2	3½	Heat Loss, B.t.u.	.203	.208	.213	.219
				Efficiency %	95.22	95.96	96.50	96.89
		2½	4	Heat Loss, B.t.u.	.185	.190	.195	.201
				Efficiency %	95.64	96.31	96.80	97.14
		3	4½	Heat Loss, B.t.u.	.171	.175	.180	.185
				Efficiency %	95.97	96.60	97.04	97.37
				Nominal pipe size 8"				
1½	11	2	3½	Heat Loss, B.t.u.	.196	.201	.206	.212
				Efficiency %	95.39	96.10	96.62	96.99
		2½	4	Heat Loss, B.t.u.	.178	.183	.188	.193
				Efficiency %	95.81	96.45	96.91	97.29
		3	4½	Heat Loss, B.t.u.	.165	.169	.173	.178
				Efficiency %	96.11	96.72	97.16	97.47
				Nominal pipe size 9"				
1½	12	2	3½	Heat Loss, B.t.u.	.190	.195	.200	.206
				Efficiency %	95.52	96.22	96.72	97.07
		2½	4	Heat Loss, B.t.u.	.173	.177	.182	.187
				Efficiency %	95.93	96.57	97.00	97.34
		3	4½	Heat Loss, B.t.u.	.160	.164	.168	.173
				Efficiency %	96.24	96.82	97.24	97.54
				Nominal pipe size 10"				
1 5/16	14	2	3 5/16	Heat Loss, B.t.u.	.182	.187	.192	.198
				Efficiency %	95.72	96.37	96.84	97.19
		2½	4 1/16	Heat Loss, B.t.u.	.166	.170	.175	.180
				Efficiency %	96.09	96.70	97.12	97.45
		3	4 5/16	Heat Loss, B.t.u.	.153	.157	.162	.167
				Efficiency %	96.40	96.95	97.34	97.63
				Nominal pipe size 12"				
1 5/16	16	2	3 5/16	Heat Loss, B.t.u.	.176	.181	.186	.191
				Efficiency %	95.85	96.49	96.95	97.28
		2½	4 1/16	Heat Loss, B.t.u.	.159	.163	.168	.173
				Efficiency %	96.26	96.84	97.24	97.54
		3	4 5/16	Heat Loss, B.t.u.	.146	.150	.155	.160
				Efficiency %	96.56	97.09	97.45	97.72
				Nominal pipe size 14"				
1½	17	2	3½	Heat Loss, B.t.u.	.176	.180	.185	.190
				Efficiency %	95.85	96.51	96.97	97.30
		2½	4	Heat Loss, B.t.u.	.158	.162	.167	.172
				Efficiency %	96.28	96.86	97.26	97.55
		3	4½	Heat Loss, B.t.u.	.144	.148	.152	.156
				Efficiency %	96.62	97.13	97.50	97.78
				Nominal pipe size 16"				
1½	19	2	3½	Heat Loss, B.t.u.	.172	.176	.181	.186
				Efficiency %	95.95	96.59	97.02	97.36
		2½	4	Heat Loss, B.t.u.	.154	.158	.163	.168
				Efficiency %	96.37	96.93	97.32	97.61
		3	4½	Heat Loss, B.t.u.	.141	.145	.149	.153
				Efficiency %	96.68	97.19	97.56	97.83
				Nominal pipe size 18"				
1½	21	2	3½	Heat Loss, B.t.u.	.168	.172	.177	.182
				Efficiency %	96.04	96.66	97.10	97.42
		2½	4	Heat Loss, B.t.u.	.150	.154	.158	.163
				Efficiency %	96.47	97.01	97.41	97.68
		3	4½	Heat Loss, B.t.u.	.137	.140	.144	.148
				Efficiency %	96.77	97.28	97.64	97.90
				Nominal pipe size 20"				
1½	23	2	3½	Heat Loss, B.t.u.	.166	.170	.175	.180
				Efficiency %	96.09	96.70	97.12	97.45
		2½	4	Heat Loss, B.t.u.	.148	.152	.156	.160
				Efficiency %	96.51	97.05	97.43	97.72
		3	4½	Heat Loss, B.t.u.	.135	.138	.142	.146
				Efficiency %	96.82	97.32	97.68	97.93
				Nominal pipe size 24"				
1½	27	2	3½	Heat Loss, B.t.u.	.162	.166	.170	.174
				Efficiency %	96.18	96.78	97.22	97.53
		2½	4	Heat Loss, B.t.u.	.144	.148	.152	.156
				Efficiency %	96.62	97.13	97.50	97.78
		3	4½	Heat Loss, B.t.u.	.131	.134	.137	.141
				Efficiency %	96.91	97.40	97.75	98.00
				Nominal pipe size 30"				
1½	33	2	3½	Heat Loss, B.t.u.	.158	.162	.166	.170
				Efficiency %	96.28	96.86	97.27	97.58
		2½	4	Heat Loss, B.t.u.	.140	.143	.147	.151
				Efficiency %	96.71	97.23	97.58	97.85
		3	4½	Heat Loss, B.t.u.	.127	.130	.133	.137
				Efficiency %	97.01	97.48	97.82	98.05

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Superex Combination Insulation (Asbesto-Sponge Felted)
Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot of pipe surface, per degree temperature difference, per hour.
Efficiencies expressed as a percentage of bare pipe losses.

Thickness of Superex insulation, inches	Pipe size of Asbesto-Sponge Felted, inches	Thickness of Asbesto-Sponge Felted, inches	Total thickness of insulation, inches		Temperature of pipe—deg. Fahr. 500	600	700	800
					Temperature difference, pipe to air—deg. Fahr. 425	525	625	725
				Nominal pipe size ½"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.840	.856	.872	.888
				Efficiency %	80.23	83.37	85.67	87.38
2	No outer layer		2	Heat Loss, B.t.u.	.755	.767	.779	.793
				Efficiency %	82.23	85.09	87.20	88.73
				Nominal pipe size ¾"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.752	.767	.782	.797
				Efficiency %	82.30	85.09	87.15	88.68
2	No outer layer		2	Heat Loss, B.t.u.	.670	.680	.692	.704
				Efficiency %	84.23	86.78	88.63	90.00
				Nominal pipe size 1"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.678	.691	.705	.719
				Efficiency %	84.04	86.57	88.42	89.78
2	No outer layer		2	Heat Loss, B.t.u.	.598	.608	.619	.630
				Efficiency %	85.92	88.18	89.83	91.05
				Nominal pipe size 1¼"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.612	.625	.638	.651
				Efficiency %	85.59	87.85	89.52	90.75
2	No outer layer		2	Heat Loss, B.t.u.	.536	.545	.555	.565
				Efficiency %	87.38	89.41	90.88	91.97
				Nominal pipe size 1½"				
1½	No outer layer		1½	Heat Loss, B.t.u.	.581	.593	.605	.617
				Efficiency %	86.32	88.48	90.06	91.23
2	No outer layer		2	Heat Loss, B.t.u.	.506	.515	.524	.533
				Efficiency %	88.09	89.99	91.39	92.43
				Nominal pipe size 2"				
1¼	4½	1	2¼	Heat Loss, B.t.u.	.379	.390	.402	.414
				Efficiency %	91.07	92.43	93.40	94.12
		1½	2¾	Heat Loss, B.t.u.	.343	.353	.364	.376
				Efficiency %	91.92	93.15	94.02	94.66
		2	3¼	Heat Loss, B.t.u.	.312	.322	.332	.343
				Efficiency %	92.66	93.75	94.55	95.12
		2½	3¾	Heat Loss, B.t.u.	.289	.298	.308	.318
				Efficiency %	93.20	94.22	94.94	95.48
		3	4¼	Heat Loss, B.t.u.	.272	.280	.289	.299
				Efficiency %	93.59	94.57	95.25	95.75
				Nominal pipe size 2½"				
1 5/16	5	1	2 5/16	Heat Loss, B.t.u.	.348	.356	.365	.375
				Efficiency %	91.80	93.09	94.00	94.67
		1½	2 5/16	Heat Loss, B.t.u.	.313	.321	.330	.339
				Efficiency %	92.63	93.77	94.58	95.18
		2	3 5/16	Heat Loss, B.t.u.	.284	.292	.300	.309
				Efficiency %	93.31	94.33	95.07	95.61
		2½	3 5/16	Heat Loss, B.t.u.	.262	.270	.278	.287
				Efficiency %	93.83	94.76	95.43	95.92
		3	4 5/16	Heat Loss, B.t.u.	.245	.253	.261	.269
				Efficiency %	94.23	95.09	95.72	96.18
				Nominal pipe size 3"				
1 5/16	6	1	2 5/16	Heat Loss, B.t.u.	.308	.315	.324	.333
				Efficiency %	92.75	93.88	94.68	95.26
		1½	3 1/16	Heat Loss, B.t.u.	.278	.286	.294	.303
				Efficiency %	93.45	94.45	95.17	95.70
		2	3 5/16	Heat Loss, B.t.u.	.253	.261	.269	.278
				Efficiency %	94.04	94.94	95.58	96.05
		2½	4 1/16	Heat Loss, B.t.u.	.234	.242	.250	.259
				Efficiency %	94.49	95.31	95.89	96.32
		3	4 5/16	Heat Loss, B.t.u.	.219	.227	.235	.243
				Efficiency %	94.84	95.60	96.14	96.55
				Nominal pipe size 3½"				
1 5/16	6	1	2 5/16	Heat Loss, B.t.u.	.309	.318	.327	.337
				Efficiency %	92.72	93.83	94.63	95.20
		1½	2 13/16	Heat Loss, B.t.u.	.275	.284	.293	.302
				Efficiency %	93.53	94.49	95.19	95.71
		2	3 5/16	Heat Loss, B.t.u.	.247	.255	.264	.273
				Efficiency %	94.18	95.05	95.66	96.12
		2½	3 5/16	Heat Loss, B.t.u.	.227	.235	.243	.252
				Efficiency %	94.66	95.44	96.01	96.42
		3	4 5/16	Heat Loss, B.t.u.	.211	.219	.227	.235
				Efficiency %	95.03	95.75	96.27	96.66
				Nominal pipe size 4"				
1 5/16	7	1	2 5/16	Heat Loss, B.t.u.	.280	.288	.296	.304
				Efficiency %	93.40	94.41	95.14	95.68
		1½	3 1/16	Heat Loss, B.t.u.	.253	.261	.269	.277
				Efficiency %	94.04	94.94	95.58	96.06
		2	3 5/16	Heat Loss, B.t.u.	.229	.236	.243	.251
				Efficiency %	94.61	95.42	96.01	96.43
		2½	4 1/16	Heat Loss, B.t.u.	.211	.218	.225	.232
				Efficiency %	95.03	95.77	96.30	96.71
		3	4 5/16	Heat Loss, B.t.u.	.197	.203	.210	.217
				Efficiency %	95.36	96.06	96.55	96.92
				Nominal pipe size 4½"				
1 5/16	7	2	3 5/16	Heat Loss, B.t.u.	.228	.235	.243	.251
				Efficiency %	94.63	95.44	96.01	96.43
		2½	3 5/16	Heat Loss, B.t.u.	.208	.215	.222	.230
				Efficiency %	95.10	95.83	96.35	96.73
		3	4 5/16	Heat Loss, B.t.u.	.192	.199	.206	.213
				Efficiency %	95.48	96.14	96.62	96.97

Thickness of Superex insulation, inches	Pipe size of Asbesto-Sponge Felted, inches	Thickness of Asbesto-Sponge Felted, inches	Total thickness of insulation, inches		Temperature of pipe—deg. Fahr. 500	600	700	800
					Temperature difference, pipe to air—deg. Fahr. 425	525	625	725
				Nominal pipe size 5"				
1½	8	2	3½	Heat Loss, B.t.u.	.212	.219	.226	.23
				Efficiency %	95.01	95.75	96.47	96.6
		2½	4	Heat Loss, B.t.u.	.194	.201	.208	.21
				Efficiency %	95.43	96.10	96.58	96.9
		3	4½	Heat Loss, B.t.u.	.181	.187	.194	.20
				Efficiency %	95.74	96.37	96.81	97.1
				Nominal pipe size 6"				
1½	9	2	3½	Heat Loss, B.t.u.	.202	.208	.215	.22
				Efficiency %	95.24	95.96	96.60	96.8
		2½	4	Heat Loss, B.t.u.	.184	.190	.196	.20
				Efficiency %	95.66	96.31	96.78	97.1
		3	4½	Heat Loss, B.t.u.	.170	.176	.182	.18
				Efficiency %	95.99	96.59	97.01	97.3
				Nominal pipe size 7"				
1½	10	2	3½	Heat Loss, B.t.u.	.194	.200	.207	.21
				Efficiency %	95.43	96.12	96.72	96.9
		2½	4	Heat Loss, B.t.u.	.176	.182	.188	.19
				Efficiency %	95.85	96.47	96.91	97.2
		3	4½	Heat Loss, B.t.u.	.162	.168	.174	.18
				Efficiency %	96.18	96.74	97.14	97.4
				Nominal pipe size 8"				
1½	11	2	3½	Heat Loss, B.t.u.	.188	.194	.200	.20
				Efficiency %	95.57	96.23	96.81	97.0
		2½	4	Heat Loss, B.t.u.	.169	.175	.181	.18
				Efficiency %	96.02	96.60	97.03	97.3
		3	4½	Heat Loss, B.t.u.	.156	.161	.167	.17
				Efficiency %	96.33	96.88	97.26	97.5
				Nominal pipe size 9"				
1½	12	2	3½	Heat Loss, B.t.u.	.182	.188	.194	.20
				Efficiency %	95.72	96.35	96.93	97.1
		2½	4	Heat Loss, B.t.u.	.164	.169	.175	.18
				Efficiency %	96.14	96.72	97.12	97.4
		3	4½	Heat Loss, B.t.u.	.151	.156	.161	.16
				Efficiency %	96.44	96.97	97.36	97.6
				Nominal pipe size 10"				
1 5/16	14	2	3 5/16	Heat Loss, B.t.u.	.175	.181	.187	.194
				Efficiency %	95.88	96.48	97.03	97.2
		2½	4 1/16	Heat Loss, B.t.u.	.158	.164	.170	.176
				Efficiency %	96.28	96.82	97.21	97.5
		3	4 5/16	Heat Loss, B.t.u.	.145	.150	.156	.162
				Efficiency %	96.58	97.09	97.44	97.7
				Nominal pipe size 12"				
1 5/16	16	2	3 5/16	Heat Loss, B.t.u.	.169	.175	.181	.187
				Efficiency %	96.02	96.60	97.06	97.34
		2½	4 1/16	Heat Loss, B.t.u.	.152	.157	.163	.169
				Efficiency %	96.42	96.95	97.32	97.60
		3	4 5/16	Heat Loss, B.t.u.	.139	.144	.149	.155
				Efficiency %	96.73	97.21	97.55	97.80
				Nominal pipe size 14"				
1½	17	2	3½	Heat Loss, B.t.u.	.167	.173	.179	.186
				Efficiency %	96.07	96.64	97.14	97.36
		2½	4	Heat Loss, B.t.u.	.149	.155	.161	.167
				Efficiency %	96.49	96.99	97.36	97.63
		3	4½	Heat Loss, B.t.u.	.137	.142	.148	.154
				Efficiency %	96.77	97.24	97.57	97.81
				Nominal pipe size 16"				
1½	19	2	3½	Heat Loss, B.t.u.	.163	.168	.174	.180
				Efficiency %	96.16	96.74	97.19	97.44
		2½	4	Heat Loss, B.t.u.	.145	.150	.155	.161
				Efficiency %	96.58	97.09	97.45	97.71
		3	4½	Heat Loss, B.t.u.	.133	.138	.143	.148
				Efficiency %	96.87	97.32	97.65	97.90
				Nominal pipe size 18"				
1½	21	2	3½	Heat Loss, B.t.u.	.160	.165	.171	.177
				Efficiency %	96.23	96.80	97.19	97.48
		2½	4	Heat Loss, B.t.u.	.143	.148	.153	.158
				Efficiency %	96.63	97.13	97.49	97.75
		3	4½	Heat Loss, B.t.u.	.130	.135	.140	.145
				Efficiency %	96.94	97.38	97.70	97.94
				Nominal pipe size 20"				
1½	23	2	3½	Heat Loss, B.t.u.	.157	.162	.167	.173
				Efficiency %	96.30	96.86	97.26	97.54
		2½	4	Heat Loss, B.t.u.	.140	.145	.150	.155
				Efficiency %	96.70	97.19	97.54	97.80
		3	4½	Heat Loss, B.t.u.	.128	.132	.137	.142
				Efficiency %	96.99	97.44	97.75	97.98
				Nominal pipe size 24"				
1½	27	2	3½	Heat Loss, B.t.u.	.154	.159	.164	.169
				Efficiency %	96.37	96.91	97.31	97.60
		2½	4	Heat Loss, B.t.u.	.137	.141	.146	.151
				Efficiency %	96.77	97.26	97.60	97.85
		3	4½	Heat Loss, B.t.u.	.125	.129	.133	.138
				Efficiency %	97.06	97.50	97.81	98.04
				Nominal pipe size 30"				
1½	33	2	3½	Heat Loss, B.t.u.	.150	.154	.159	.164
				Efficiency %	96.47	97.01	97.39	97.67
		2½	4	Heat Loss, B.t.u.	.133	.137	.141	.146
				Efficiency %	96.87	97.34	97.68	97.93
		3	4½	Heat Loss, B.t.u.	.121	.125	.129	.133
				Efficiency %	97.15	97.57	97.88	98.11

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Pre-Shrunk Asbestocel Pipe Insulation

For temperatures to 300 deg. F.

J-M Pre-Shrunk Asbestocel is an improved cellular type of insulation, made up of alternate layers of plain and corrugated asbestos felts, for use on pipes conveying low pressure steam and hot water.

This material affords positive assurance against shrinkage troubles, the major shortcoming of the old style cellular pipe insulation. The old style material, made of ordinary asbestos paper, readily absorbs moisture ("breathes") while in stock or during handling and consequently expands. After the insulation is applied to a pipe, the heat of the line dries it out, causing the material to shrink and the sections to pull apart at the joints.

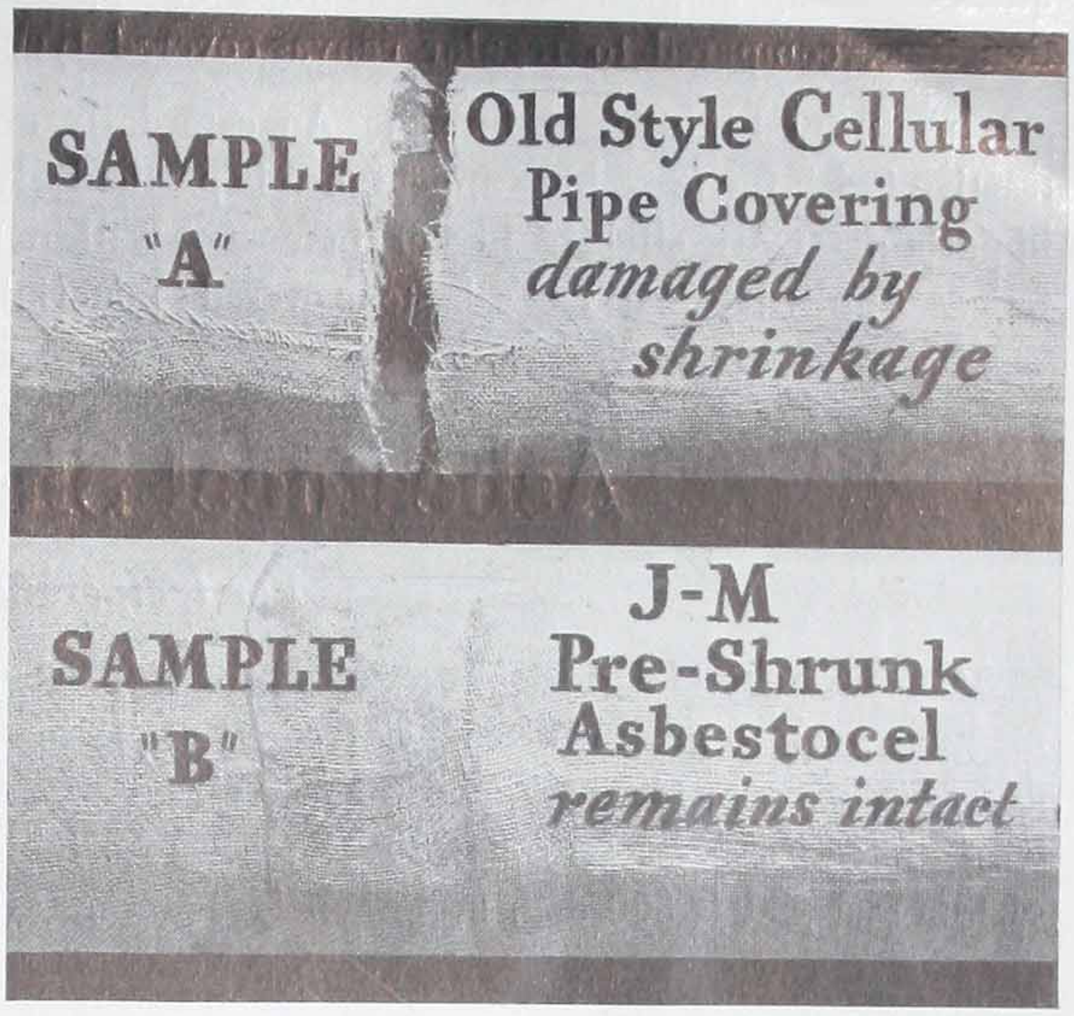
Pre-Shrunk Asbestocel, on the other hand, is made of specially-treated, moisture-resistant asbestos paper which prevents "breathing" and thus removes the cause of objectionable shrinkage cracks.

Pre-Shrunk Asbestocel, moreover, is fabricated with an improved type of corrugation which affords greater strength and a more uniform appearance. Because of up-to-date manufacturing facilities, all these advantages are available in J-M Pre-Shrunk Asbestocel at no extra cost.

Sizes and Thicknesses

Pre-Shrunk Asbestocel is furnished to fit standard pipe sizes, in 3-ft. long sections in standard thicknesses of 2 to 8 plies, each ply approximately ¼" thick. Greater thicknesses can be furnished on order.

Pre-Shrunk Asbestocel can also be supplied in sections to fit straight runs of copper pipe or tubing with the following outside diameters: ⅜", ½", ⅝", ⅞", 1⅛", 1⅜", 1⅝", 2⅛", 2⅝", 3⅛", 3⅝", 4⅛", 5⅛" and 6⅛".



Samples of insulation tested under identical conditions reveal the superiority of Pre-Shrunk Asbestocel in overcoming objectionable shrinkage cracks

Standard Finishes

Through the elimination of objectionable shrinkage the use of a non-canvas finish on cellular pipe insulation is now practical. With such finishes, according to numerous tests, the time involved in applying the insulation can be reduced at least one-third.

Pre-Shrunk Asbestocel is supplied in three finishes:

Regular canvas-covered: The standard finish for many years in cellular pipe coverings.

Asbestos-covered high-speed finish: With an attractive asbestos paper finish. Costs no more than regular canvas-covered Pre-Shrunk Asbestocel. Re-

Number of feet and sections and approximate gross weight per standard carton

Nominal Pipe Size, inches	2-Ply				3-Ply				4-Ply			
	Lin. ft. of Insulation	No. of 3-ft. Sections	Weight, lb.		Lin. ft. of Insulation	No. of 3-ft. Sections	Weight, lb.		Lin. ft. of Insulation	No. of 3-ft. Sections	Weight, lb.	
			Canvas Cover	Other Covers			Canvas Cover	Other Covers			Canvas Cover	Other Covers
½	180	60	57	63	120	40	51	61	84	28	52	62
¾	150	50	50	60	105	35	49	57	72	24	48	56
1	120	40	47	54	84	28	45	52	60	20	44	49
1¼	90	30	42	45	69	23	41	49	51	17	39	46
1½	84	28	42	46	60	20	39	45	45	15	39	43
2	60	20	35	39	45	15	33	39	36	12	35	40
2½	45	15	30	34	36	12	31	36	33	11	36	39
3	36	12	29	32	27	9	27	31	21	7	30	31
3½	24	8	24	28	21	7	25	27	18	6	27	27
4	33	11	30	33	27	9	32	39	21	7	36	42
4½	30	10	32	31	21	7	32	35	18	6	32	37
5	21	7	25	32	18	6	27	33	15	5	30	35
6	18	6	28	32	15	5	26	31	12	4	28	31

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quires no pasting—a high-speed insulation that slips easily over the pipe and clinches on tight with simple, quick-fastening staples. Saves one-third in application time, compared to regular canvas-covered type.

Aluminum high-speed finish: An especially attractive finish for use where appearance is particularly important. Only slightly higher in cost. Will not fade. Applied same as asbestos-covered material.

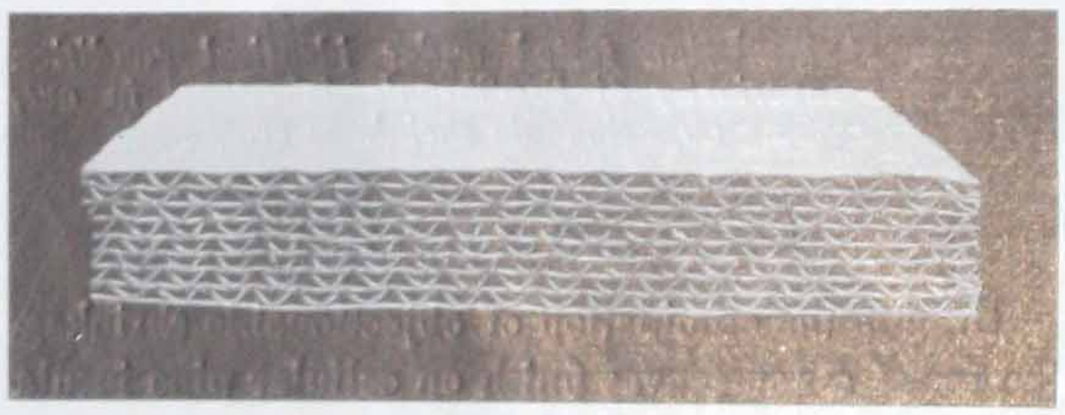
Fine Corrugated Pre-Shrunk Asbestoce

Pre-Shrunk Asbestocel is also furnished six plie to the inch, with regular canvas jacket, known as Fin Corrugated Pre-Shrunk Asbestocel. The smaller cor rugations provide greater strength and efficiency Standard thicknesses are 4, 6 and 9 plies, each ply ap proximately 1/6″ thick. Also 2-ply and greater tha 9-ply are furnished on order.

Asbestocel Sheets and Blocks

For temperatures to 300 deg. F.

Asbestocel sheets and blocks are used for insulating medium or low pressure boilers, feed-water heaters, dry rooms, warm air ducts and other surfaces whose temperatures are not extreme. The temperature limit of this material is 300 deg. F.



The sheets and blocks are made of alternate plain and corrugated asbestos felts, built up in layers to the proper thickness.

Asbestocel is furnished standard in 4 plies per inch of thickness in sizes 6″, 9″, 12″, 18″ and 36″ wide by 36″ and 72″ long, from ½″ to 4″ in thickness. Weigh of 4-ply material approximately 1 lb. per sq. ft. per inch of thickness.

This material can also be furnished in 6 plies per inch of thickness, known as Fine Corrugated Asbestocel, in the same sizes as the coarse-corrugated material Weight of Fine Corrugated is approximately 1.3 lb per sq. ft. per inch thick.

Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot, per degree temperature difference, per hour.
Efficiency expressed in percent of bare surface losses.

Insulation thickness, inches		Temperature of surface—deg. Fahr. 125	175	225	275
		Temperature difference between surface and air—deg. Fahr. 50	100	150	200
1	Heat Loss, B.t.u.	.411	.424	.444	.464
	Efficiency %	78.90	80.30	81.50	82.59
1½	Heat Loss, B.t.u.	.295	.306	.320	.335
	Efficiency %	84.86	85.79	86.67	87.43
2	Heat Loss, B.t.u.	.231	.239	.250	.262
	Efficiency %	88.15	88.90	89.60	90.16
2½	Heat Loss, B.t.u.	.190	.197	.206	.216
	Efficiency %	90.25	90.85	91.40	91.90
3	Heat Loss, B.t.u.	.161	.167	.175	.183
	Efficiency %	91.76	92.25	92.71	93.14
3½	Heat Loss, B.t.u	.140	.145	.152	.159
	Efficiency %	92.83	93.25	93.68	94.04
4	Heat Loss, B.t.u.	.123	.128	.134	.141
	Efficiency %	93.69	94.06	94.42	94.71

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Pre-Shrunk Asbestocel (sectional) Heat Losses and Efficiencies

Heat losses expressed in B.t.u. per square foot of pipe surface, per degree temperature difference, per hour.
Efficiency expressed in percent of bare pipe losses.

Insulation thickness		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300
		Nominal pipe size ½″					
2-ply	Heat Loss, B.t.u.	1.020	1.082	1.147	1.215	1.287	1.363
	Efficiency %	47.72	49.73	52.22	54.42	56.39	58.19
3-ply	Heat Loss, B.t.u.	.914	.966	1.020	1.076	1.134	1.194
	Efficiency %	53.13	55.11	57.51	59.63	61.57	63.37
4-ply	Heat Loss, B.t.u.	.847	.894	.943	.994	1.047	1.102
	Efficiency %	56.58	58.45	60.71	62.70	64.52	66.19
		Nominal pipe size ¾″					
2-ply	Heat Loss, B.t.u.	.927	.984	1.044	1.107	1.173	1.242
	Efficiency %	52.48	54.28	56.49	58.47	60.29	61.89
3-ply	Heat Loss, B.t.u.	.824	.873	.923	.975	1.028	1.082
	Efficiency %	57.75	59.43	61.54	63.42	65.17	66.81
4-ply	Heat Loss, B.t.u.	.755	.799	.844	.890	.937	.985
	Efficiency %	61.29	62.86	64.83	66.60	68.25	69.78
		Nominal pipe size 1″					
2-ply	Heat Loss, B.t.u.	.853	.908	.965	1.024	1.085	1.148
	Efficiency %	56.27	57.81	59.80	61.58	63.23	64.77
3-ply	Heat Loss, B.t.u.	.755	.799	.844	.890	.938	.988
	Efficiency %	61.29	62.86	64.83	66.60	68.22	69.69
4-ply	Heat Loss, B.t.u.	.684	.724	.765	.807	.850	.894
	Efficiency %	64.93	66.35	68.12	69.72	71.20	72.58
		Nominal pipe size 1¼″					
2-ply	Heat Loss, B.t.u.	.794	.845	.898	.953	1.010	1.070
	Efficiency %	59.29	60.73	62.59	64.24	65.78	67.18
3-ply	Heat Loss, B.t.u.	.692	.733	.775	.818	.862	.908
	Efficiency %	64.52	65.93	67.70	69.31	70.79	72.13
4-ply	Heat Loss, B.t.u.	.623	.660	.698	.736	.775	.814
	Efficiency %	68.05	69.33	70.91	72.38	73.73	75.02
		Nominal pipe size 1½″					
2-ply	Heat Loss, B.t.u.	.764	.813	.864	.917	.972	1.030
	Efficiency %	60.83	62.22	64.00	65.60	67.07	68.39
3-ply	Heat Loss, B.t.u.	.660	.699	.739	.780	.822	.866
	Efficiency %	66.16	67.52	69.21	70.73	72.15	73.43
4-ply	Heat Loss, B.t.u.	.592	.627	.663	.699	.736	.774
	Efficiency %	69.64	70.85	72.37	73.78	75.05	76.24
		Nominal pipe size 2″					
2-ply	Heat Loss, B.t.u.	.717	.764	.813	.864	.918	.975
	Efficiency %	63.23	64.49	66.12	67.58	68.89	70.10
3-ply	Heat Loss, B.t.u.	.615	.652	.690	.729	.769	.811
	Efficiency %	68.47	69.71	71.25	72.64	73.93	75.12
4-ply	Heat Loss, B.t.u.	.547	.580	.613	.647	.682	.717
	Efficiency %	71.95	73.04	74.45	75.72	76.89	78.00
		Nominal pipe size 2½″					
2-ply	Heat Loss, B.t.u.	.686	.732	.780	.830	.882	.936
	Efficiency %	64.82	65.97	67.50	68.86	70.11	71.29
3-ply	Heat Loss, B.t.u.	.586	.619	.654	.691	.730	.771
	Efficiency %	69.95	71.23	72.74	74.07	75.27	76.35
4-ply	Heat Loss, B.t.u.	.517	.547	.578	.610	.643	.677
	Efficiency %	73.49	74.57	75.91	77.11	78.22	79.23
		Nominal pipe size 3″					
2-ply	Heat Loss, B.t.u.	.662	.706	.752	.800	.850	.902
	Efficiency %	66.05	67.19	68.67	69.99	71.20	72.33
3-ply	Heat Loss, B.t.u.	.557	.589	.623	.659	.697	.737
	Efficiency %	71.43	72.62	74.03	75.28	76.38	77.39
4-ply	Heat Loss, B.t.u.	.489	.518	.548	.578	.609	.641
	Efficiency %	74.93	75.92	77.17	78.31	79.37	80.33
		Nominal pipe size 3½″					
2-ply	Heat Loss, B.t.u.	.645	.688	.733	.780	.829	.881
	Efficiency %	66.93	68.03	69.45	70.73	71.91	72.82
3-ply	Heat Loss, B.t.u.	.540	.573	.607	.642	.678	.715
	Efficiency %	72.31	73.38	74.70	75.91	77.03	78.07
4-ply	Heat Loss, B.t.u.	.471	.500	.529	.559	.589	.620
	Efficiency %	75.85	76.75	77.96	79.02	80.04	80.98

Insulation thickness		Temperature of pipe—deg. Fahr. 125	175	225	275	325	375
		Temperature difference between pipe and air—deg. Fahr. 50	100	150	200	250	300
		Nominal pipe size 4″					
2-ply	Heat Loss, B.t.u.	.633	.675	.719	.765	.814	.866
	Efficiency %	67.53	68.62	70.03	71.29	72.42	73.43
3-ply	Heat Loss, B.t.u.	.528	.560	.593	.627	.662	.698
	Efficiency %	72.92	73.96	75.29	76.47	77.57	78.58
4-ply	Heat Loss, B.t.u.	.458	.486	.515	.544	.574	.604
	Efficiency %	76.52	77.41	78.54	79.58	80.55	81.47
		Nominal pipe size 4½″					
2-ply	Heat Loss, B.t.u.	.622	.664	.708	.754	.802	.852
	Efficiency %	68.11	69.13	70.49	71.70	72.82	73.87
3-ply	Heat Loss, B.t.u.	.517	.549	.582	.616	.651	.687
	Efficiency %	73.49	74.48	75.74	76.88	77.94	78.93
4-ply	Heat Loss, B.t.u.	.449	.476	.504	.532	.561	.590
	Efficiency %	76.97	77.87	79.00	80.03	80.99	81.90
		Nominal pipe size 5″					
2-ply	Heat Loss, B.t.u.	.615	.656	.699	.744	.791	.841
	Efficiency %	68.47	69.51	70.88	72.08	73.19	74.20
3-ply	Heat Loss, B.t.u.	.508	.539	.571	.604	.638	.674
	Efficiency %	73.94	74.94	76.21	77.33	78.38	79.33
4-ply	Heat Loss, B.t.u.	.438	.465	.493	.521	.549	.578
	Efficiency %	77.54	78.38	79.45	80.45	81.40	82.27
		Nominal pipe size 6″					
2-ply	Heat Loss, B.t.u.	.605	.645	.687	.731	.777	.826
	Efficiency %	68.98	70.02	71.38	72.57	73.68	74.66
3-ply	Heat Loss, B.t.u.	.495	.525	.556	.588	.621	.656
	Efficiency %	74.62	75.59	76.83	77.93	78.96	79.87
4-ply	Heat Loss, B.t.u.	.425	.451	.477	.504	.532	.560
	Efficiency %	78.21	79.03	80.12	81.08	81.97	82.82
		Nominal pipe size 7″					
2-ply	Heat Loss, B.t.u.	.592	.632	.674	.718	.764	.812
	Efficiency %	69.64	70.63	71.91	73.05	74.11	75.09
3-ply	Heat Loss, B.t.u.	.484	.514	.545	.577	.610	.644
	Efficiency %	75.18	76.11	77.29	78.34	79.33	80.24
4-ply	Heat Loss, B.t.u.	.415	.441	.467	.493	.520	.548
	Efficiency %	78.72	79.51	80.53	81.49	82.38	83.19
		Nominal pipe size 8″					
2-ply	Heat Loss, B.t.u.	.585	.625	.667	.711	.757	.805
	Efficiency %	70.00	70.96	72.20	73.32	74.35	75.31
3-ply	Heat Loss, B.t.u.	.479	.508	.538	.569	.601	.635
	Efficiency %	75.43	76.39	77.58	78.64	79.63	80.52
4-ply	Heat Loss, B.t.u.	.409	.434	.459	.485	.512	.539
	Efficiency %	79.03	79.83	80.87	81.80	82.65	83.47
		Nominal pipe size 9″					
2-ply	Heat Loss, B.t.u.	.580	.621	.663	.706	.751	.798
	Efficiency %	70.24	71.14	72.37	73.50	74.55	75.52
3-ply	Heat Loss, B.t.u.	.470	.499	.529	.560	.592	.625
	Efficiency %	75.89	76.81	77.96	78.97	79.93	80.83
4-ply	Heat Loss, B.t.u.	.401	.426	.451	.477	.503	.530
	Efficiency %	79.43	80.21	81.21	82.10	82.95	83.74
		Nominal pipe size 10″					
2-ply	Heat Loss, B.t.u.	.575	.615	.656	.699	.744	.791
	Efficiency %	70.51	71.41	72.66	73.78	74.79	75.73
3-ply	Heat Loss, B.t.u.	.465	.494	.524	.555	.587	.620
	Efficiency %	76.14	77.04	78.17	79.17	80.11	80.98
4-ply	Heat Loss, B.t.u.	.398	.421	.445	.470	.496	.523
	Efficiency %	79.58	80.43	81.46	82.36	83.19	83.95
		Nominal pipe size 12″					
2-ply	Heat Loss, B.t.u.	.565	.604	.645	.688	.733	.780
	Efficiency %	71.02	71.93	73.11	74.18	75.16	76.07
3-ply	Heat Loss, B.t.u.	.457	.486	.516	.547	.579	.612
	Efficiency %	76.56	77.41	78.49	79.47	80.37	81.22
4-ply	Heat Loss, B.t.u.	.390	.414	.438	.463	.488	.514
	Efficiency %	80.00	80.76	81.75	82.62	83.46	84.23

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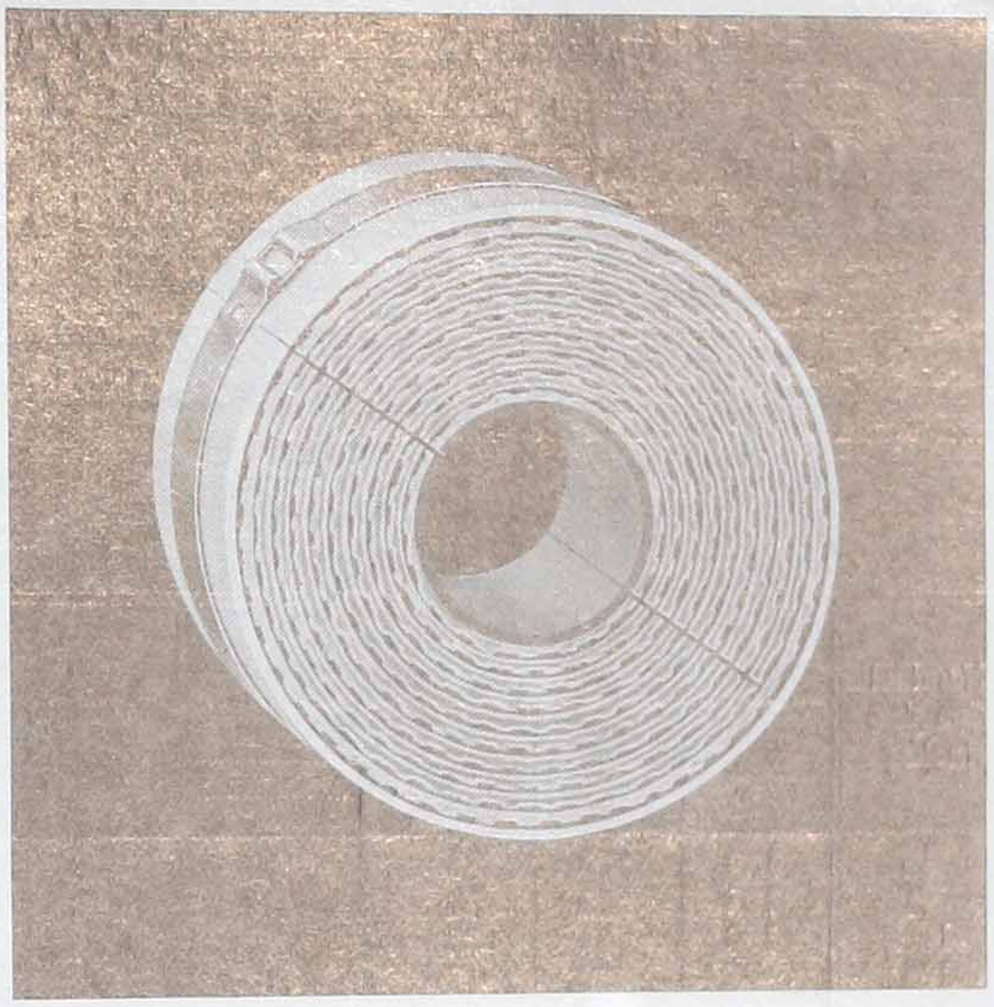
J-M Pre-Shrunk Wool Felt Pipe Insulation

For hot and cold water service lines

To promote quicker delivery of water of the desired temperature at the faucet and to prevent sweating of cold water lines, insulation of hot and cold water service lines is highly desirable. The convenience and economy which such insulation assures have long been recognized as essential by hotel, apartment house and office building operators and are being more generally demanded by home owners.

J-M Pre-Shrunk Wool Felt Pipe Insulation is an effective and economical material for keeping hot water hot, for keeping cold water cold and to prevent sweating of cold water lines. Like Pre-Shrunk Asbestocel, J-M Pre-Shrunk Wool Felt is made of moisture-resisting felts which prevent the objectionable absorption of moisture in storage, thus minimizing drying shrinkage and pulling apart at the joints after application.

The sheets of wool felt of which the material is composed are indented by a special manufacturing process, an operation which reduces the conductivity of the finished material approximately 25 percent, as compared with ordinary wool felt. The insulation made with this indented material is also from 16 to 20 percent lighter in weight.

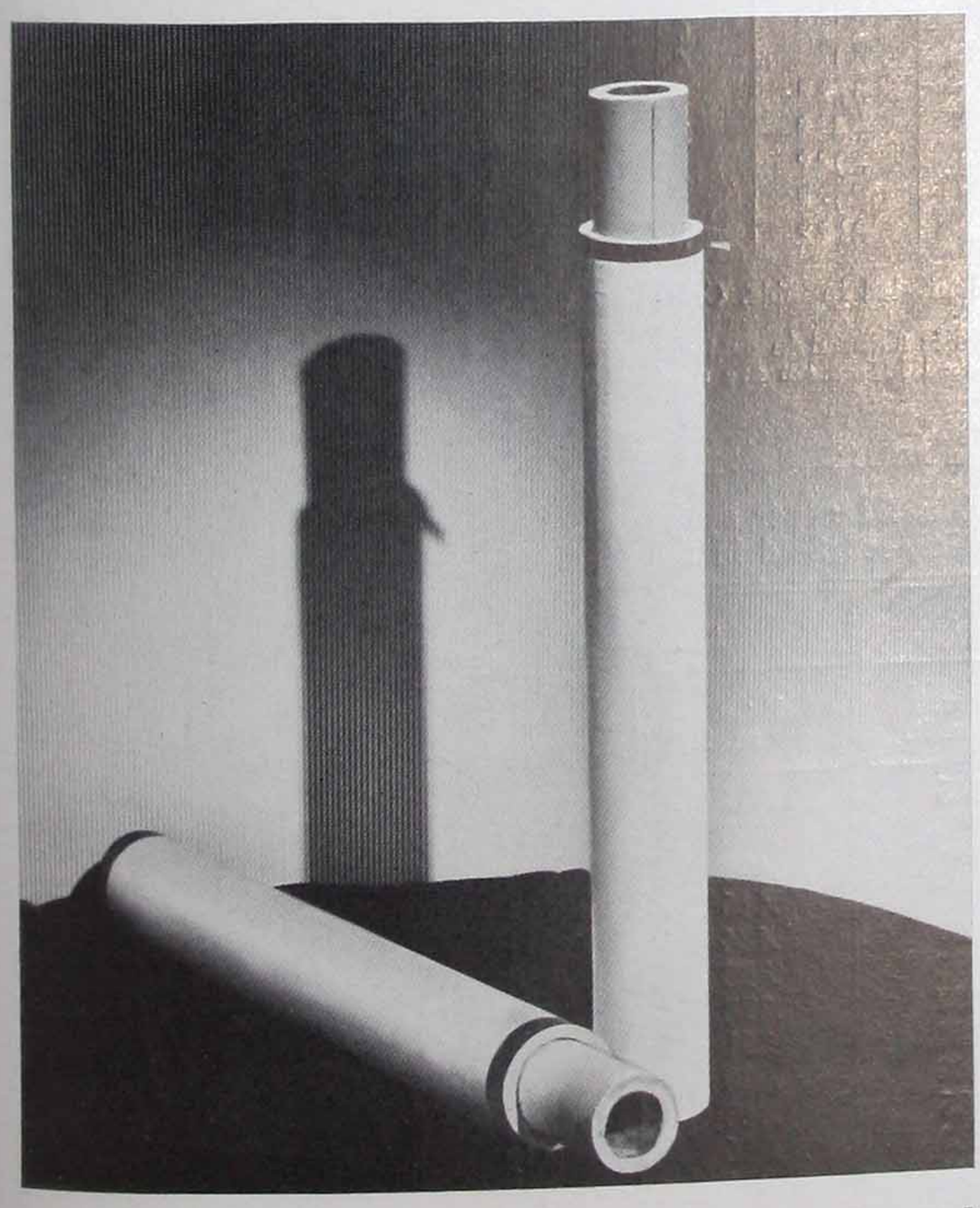


Another distinctive feature of J-M Pre-Shrunk Wool Felt is the dual-service liner—an asphalt-saturated felt. The waterproof quality of this felt liner makes J-M Wool Felt perfectly suited to cold water lines, and as the liner will withstand temperatures as high as 225 deg. F., the material is equally satisfactory for hot water pipes.

Finishes:

The insulation is available in two finishes, the regular canvas and a smooth, dull-coated aluminum. Where pipes may be exposed to view, as in basement playrooms, the aluminum finish is more desirable. This finish is attractive, and it does not crease or crack when the sections are opened for application. While the aluminum finish is slightly higher in price than canvas, it saves one-third in installation labor because no additional finish is required. The sections are held tightly in place with staples and bands which are quickly applied.

An integral waterproof jacket can be supplied with the insulation when so ordered.



J-M Pre-Shrunk Wool Felt is equally efficient on hot and cold water service lines

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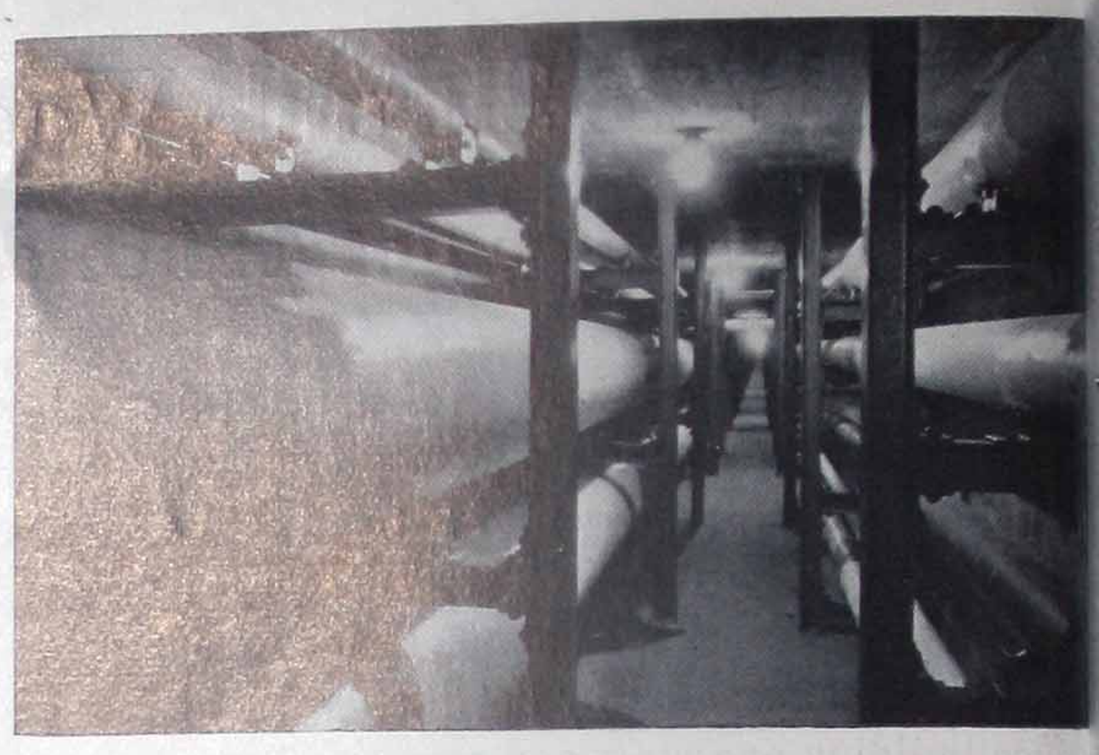
Sizes and Thicknesses:

In both finishes, J-M Pre-Shrunk Wool Felt is supplied in sections 3 ft. long, in thicknesses of ½", ¾", 1", Double ½" and Double ¾" for pipe sizes of ½" and larger. It is also furnished to fit straight runs of copper pipe and tubing of outside diameters from ⅜" up. The double layer construction of Double ½" and Double ¾" thicknesses permits the breaking of all through joints.

Bands for use with the insulation are included in each carton, brass lacquered bands with the canvas finish and black lacquered bands with the aluminum finish. Staples, also, are furnished with the aluminum finish for use in applying the sections.



J-M Wool Felt on lines in walking tunnel. United Aircraft & Transport Corp., East Hartford, Conn.

Carton Contents and Approximate Weights

Nominal pipe size, inches	½" Thickness (per carton)				¾" Thickness (per carton)				1" Thickness and Double ½" Thickness* (per carton)			
	Feet	Sections	Approx. gross wgt., lb.		Feet	Sections	Approx. gross wgt., lb.		Feet	Sections	Approx. gross wgt., lb.	
			Canvas finish	Aluminum finish**			Canvas finish	Aluminum finish**			Canvas finish	Aluminum finish**
½	180	60	83	91	120	40	81	88	84	28	87	92
¾	135	45	70	77	108	36	80	87	72	24	81	85
1	123	41	73	80	84	28	72	78	60	20	76	81
1¼	96	32	65	71	72	24	70	75	51	17	71	77
1½	84	28	64	70	60	20	65	71	45	15	70	74
2	63	21	56	61	45	15	56	60	36	12	63	66
2½	45	15	47	51	36	12	52	55	30	10	61	63
3	36	12	44	48	27	9	46	49	24	8	57	60
3½	27	9	38**	40	21	7	40**	43	18	6	48**	50
4	21	7	35**	37	18	6	40	42	18	6	54	56
4½	18	6	33**	35	15	5	37**	39	15	5	50**	51
5	18	6	36**	38	12	4	33**	34	9	3	34**	35
6	9	3	24**	25	9	3	30**	32	6	2	28**	29
8	6	2	21**	22	6	2	26**	28	6	2	35**	36
10	6	2	24**	26	6	2	31**	32	3	1	23**	24

Standard cartons, 20½" x 14" x 36¾" (O.D.), are used for all sizes indicated in table. Crates are used for larger diameter insulation and for special shipments.
*Also available in Double ¾" thickness on order. Double ¾" thickness is shipped in crates.
**Canvas finished insulation in the sizes indicated and all aluminum finished insulation are made to order only.

Rates of Heat Transmission

The rates of heat transmission given below are expressed in B.t.u. per square foot (and also per linear foot) of pipe surface, per hour, per degree temperature difference between fluid in the pipe and air surrounding the pipe.

Nominal pipe size, inches	½" Thickness		¾" Thickness		1" Thickness		1½" Thickness	
	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.
½	.776	.171	.658	.145	.585	.129	.495	.109
¾	.719	.198	.605	.166	.530	.146	.444	.122
1	.670	.231	.556	.191	.483	.166	.398	.137
1¼	.633	.275	.516	.225	.446	.194	.362	.158
1½	.610	.304	.495	.247	.424	.211	.343	.171
2	.581	.362	.469	.292	.398	.248	.316	.197
2½	.561	.423	.448	.337	.378	.285	.298	.224
3	.545	.500	.430	.394	.361	.331	.281	.258
3½	.535	.560	.420	.440	.350	.366	.271	.284
4	.527	.621	.412	.485	.343	.404	.264	.311
4½	.520	.681	.405	.530	.336	.440	.257	.336
5	.514	.748	.399	.581	.331	.482	.251	.365
6	.505	.876	.389	.675	.321	.557	.243	.421
8	.495	1.117	.380	.858	.311	.702	.233	.526
10	.488	1.375	.372	1.048	.304	.856	.225	.634

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J-M Rock Cork Pipe Insulation

J-M Rock Cork Pipe Insulation and Zerotex Built-up Fitting Insulation are used on pipe lines carrying ice water, brine, ammonia and other refrigerated fluids. Since both are mineral in composition, they combine all of the properties essential to a highly efficient and permanent cold pipe insulation.

Rock Cork and Zerotex for the insulation of pipe lines embody all the desirable features of Rock Cork sheets which have been used with exceptional success in cold storage insulation for over 29 years.

Both the pipe and fitting insulation have a remarkably high resistance to moisture infiltration which causes most cold pipe insulation failures. Newly developed features permitting hermetic sealing give further assurance of permanence under service conditions.

Rock Cork and Zerotex are odorless and vermin-proof and since they are inorganic, will not decay or support the growth of bacteria.

Rock Cork Pipe Insulation

J-M Rock Cork Pipe Insulation is manufactured from Banroc, a loose rock wool, which is bonded with a waterproof compound. It is furnished with a factory-applied integral waterproof jacket, in single layer sections, 3 ft. long, to fit all standard pipe sizes. Sectional insulation is shipped in sturdy wooden crates to insure delivery in good condition. For larger pipe sizes segmental insulation is furnished.

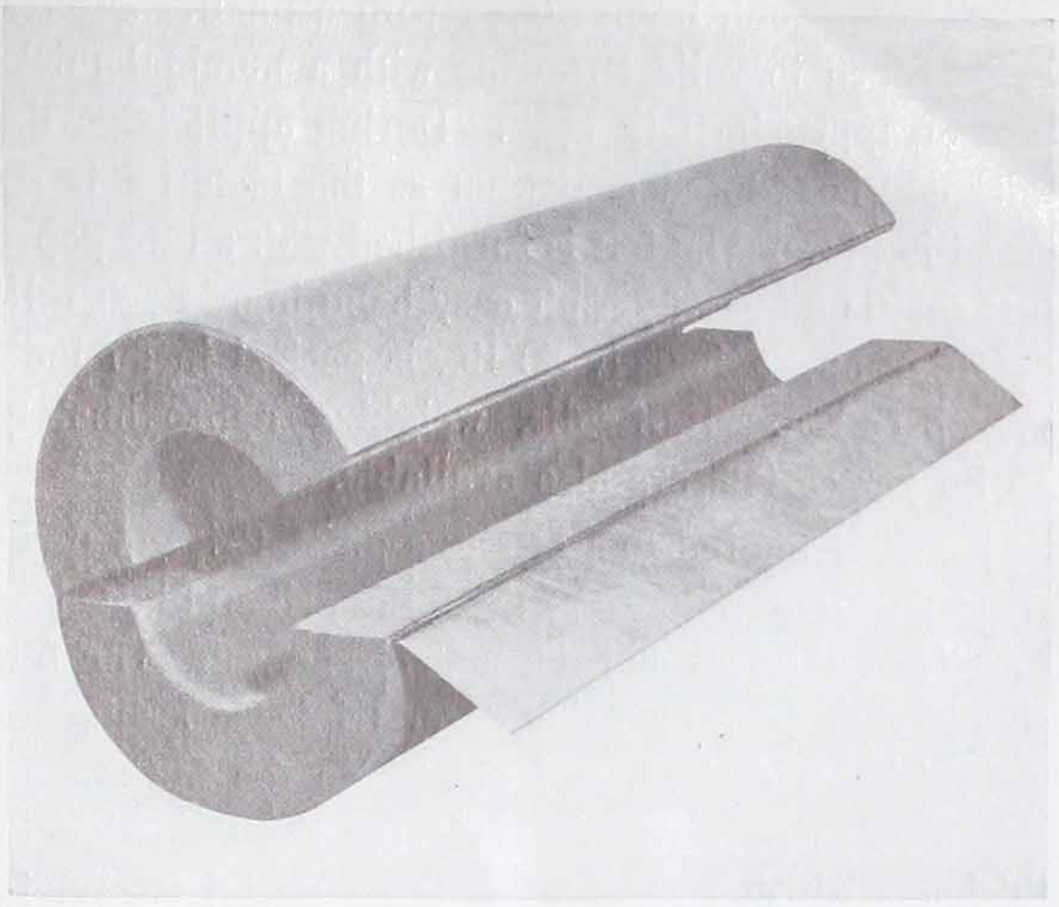
The integral waterproof jacket of the sectional pipe insulation protects both longitudinal joints, eliminating dependence upon seam filling compounds. In addition, it increases considerably the speed of application as a complete section can be applied as a unit.

Rock Cork Lagging, used as an outer application over the sectional insulation for very low temperature work, is supplied 1½ ft. and 3 ft. long depending upon pipe size and thickness of the lagging. It is furnished 1½″, 2″, 3″ and 4″ thick. Lagging is also used on very large pipe, small tanks and cylinders.

On special order the insulation can be supplied to fit straight runs of ¼″ to 3″ brass and copper tubing. Outside diameter of tubing must be stated in the order.

A definite thickness of insulation is supplied for each size of pipe according to the individual service requirements, as indicated in the next column.

When other conditions prevail, recommendations should be secured from Johns-Manville.



The integral waterproof jacket affords tighter joints and facilitates the application of the insulation

Service Recommendations:

Ice Water thickness is used for water, liquid ammonia and other cold lines between 30 and 45 deg. F. It varies from 1.4″ to 2″ in thickness, according to pipe size. For pipe sizes over 10″, the insulation is furnished in segmental form.

Brine thickness is used for pipes conveying brine, ammonia and other cold lines operating between 0 to 30 deg. F. It varies in thickness from 1.97″ to 3.19″ according to pipe size. Furnished in segmental form for pipe larger than 8″.

Heavy Brine thickness is used for pipes conveying brine, ammonia or other refrigerants operating at temperatures from 0 to –30 deg. F. The thickness varies from 2.82″ to 4″ increasing with the pipe size. For pipes larger than 6″, the insulation is furnished in segmental form.

Temperatures below –30 deg. F.: On pipe lines operating at temperatures from –30 to –50 deg. F., Heavy Brine thickness with an outer application of J-M Rock Cork Lagging is recommended. On pipe sizes from 1¼″ to 4″, the 1½″ lagging is used. On pipe sizes over 4″, the 2″ lagging is applied.

When service temperatures range from –50 to –70 deg. F., on pipe sizes from 1¼″ to 4″, the 2″ lagging is used over Heavy Brine thickness. On pipe sizes over 4″, the 3″ thickness of lagging is recommended.

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Zerotex Built-up Fitting Insulation

All fittings are insulated with J-M Zerotex, a loosely felted rock wool, impregnated with asphalt. Zerotex is furnished in rolls 18″ wide with a nominal thickness of approximately 1½″. During application the thickness is reduced somewhat as the material is secured in place. The felt is furnished with a thin paper between the plies to permit easy handling. Each roll, weighing approximately 30 lb., is packed in an individual carton. Half-rolls, weighing approximately 15 lb. per carton, are also available.

To apply the felt to a fitting, a piece, twice or three times the circumference of the fitting, should be cut or torn from the roll and the paper removed. The felt should then be folded double or triple, according to the thickness desired, and placed on the fitting. In this manner provision is made for the reduction in thickness which results when the material is tied in place. Additional pieces of Zerotex may be torn from the roll and stuffed into low spots in the fitting to assure a proper thickness.

Zerotex Built-up Fitting Insulation has proved its worth under service conditions for an extended period of time. It offers decided advantages over rigid or pre-cast types of fitting insulation. The material can be readily adapted to any style of fitting with complete assurance of a tight, moisture-proof installation. Since all fittings are insulated with the same material, the necessity of maintaining expensive stocks of fitting jackets is eliminated.

Accessories

The following materials are required in the application of J-M Rock Cork Pipe Insulation:

J-M Zeroseal: A special heavy-bodied plastic cement composed of asbestos fibre, asphalt and other mineral ingredients, designed to afford thorough water-tightness. It is used to seal all joints on sectional or segmental insulation and to close all pores in the sealing membrane of Zerotape which is applied over Zerotex on fittings. It is furnished in 10, 25, 50 and 150-lb. containers. One gal. weighs about 10 lb.

J-M Zerotape: A high-grade waterproof fabric used as a sealing membrane over Zerotex on fittings and over end joints on pipe insulation. It is furnished in 3″-wide rolls weighing approximately 1.2 lb.

J-M Zerogloss: A moisture-resistant compound of ground asbestos fibre and asphalt which is used to give a bright black protective finish to the entire installation, both pipe and fittings. It is furnished in ½, 1 and 5-gal. cans and 30-gal. drums.

Sufficient Zeroseal, Zerotape and Zerogloss, as well as copperized staples and copper-covered annealed steel wire, are shipped with the pipe insulation for use in applying the material in accordance with application directions. If specified on the order, galvanized steel straps and seals will be furnished instead of wire at slight extra cost.

Zerotex and accessories for insulating fittings should be ordered separately.

List prices of Rock Cork Pipe Insulation per linear foot

Nominal size, pipe inches	O. D. pipe, inches	Ice Water Thickness			Brine Thickness			Heavy Brine Thickness		
		O.D. insulation, inches	Thickness of insulation, inches	List price per lin. ft.	O.D. insulation, inches	Thickness of insulation, inches	List price per lin. ft.	O.D. insulation, inches	Thickness of insulation, inches	List price per lin. ft.
¼	.540	3.5	1.45	$1.00	4.5	1.98	$1.25	6.5	2.97	$2.10
⅜	.675	3.5	1.40	1.00	4.5	1.91	1.25	6.5	2.90	2.10
½	.840	4.0	1.58	1.00	5.0	2.08	1.25	6.5	2.82	2.10
¾	1.050	4.5	1.72	1.05	5.0	1.97	1.35	7.0	2.97	2.25
1	1.315	4.5	1.59	1.20	5.5	2.09	1.55	7.5	3.09	2.60
1¼	1.666	5.0	1.67	1.25	6.5	2.42	2.00	8.0	3.16	2.90
1½	1.900	5.0	1.52	1.40	7.0	2.55	2.25	8.5	3.30	3.00
2	2.375	5.5	1.55	1.55	7.5	2.56	2.35	9.0	3.31	3.50
2½	2.875	6.0	1.56	1.65	8.0	2.56	2.70	9.5	3.31	3.65
3	3.500	6.5	1.50	1.85	9.0	2.75	3.30	10.5	3.49	3.95
3½	4.000	7.0	1.50	2.25	10.0	3.00	3.65	11.0	3.50	5.30
4	4.500	8.0	1.75	2.55	10.5	2.97	3.95	12.0	3.75	5.50
5	5.563	9.0	1.72	2.95	11.5	2.99	4.80	13.5	3.97	6.35
6	6.625	10.0	1.68	4.20	13.0	3.19	5.80	14.5	3.92	7.80
8	8.625	12.5	1.94	5.50	15.0	3.19	6.80	17.0	4.18	13.00
10	10.750	14.5	1.87	8.00	17.0	3.125	11.45	19.0	4.12	14.85
12	12.750	16.5	1.875	8.45	19.0	3.125	12.35	20.75	4.0	16.10
14	14.000	18.0	2.00	9.05	20.0	3.00	14.00	22.0	4.0	*

Sizes below heavy black line are furnished in segmental form. *Lagging is furnished for this pipe size.

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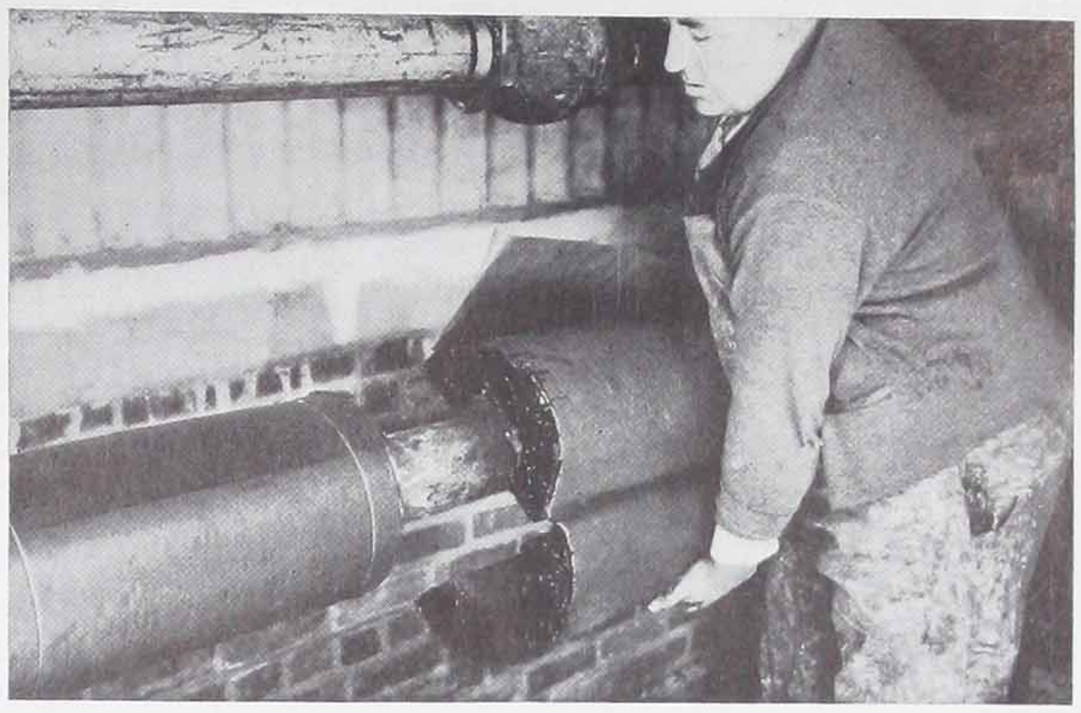
Application of J-M Rock Cork Pipe Insulation

Proper application is equally as important as proper materials in the success of refrigerated pipe insulation. J-M Rock Cork Pipe Insulation, properly installed, will give satisfaction over a long period.

Spacing of the Lines:

Sufficient space must be allowed between pipes and adjacent surfaces to permit easy application of the full thickness of insulation. Dimensions required for the minimum spacing of pipe lines follow:

Insulation thickness	Space required between parallel pipes, inches	Space required between pipe and adjacent surfaces, inches
Ice Water Thickness		
Up to 6″ pipe—screwed fittings	7	5
Larger than 6″ pipe—screwed fittings	11	6
All pipe sizes—flanged fittings	12	8
Brine Thickness		
Up to 6″ pipe—screwed fittings	9	7
Larger than 6″ pipe—screwed fittings	15	9
All pipe sizes—flanged fittings	16	10
Heavy Brine Thickness		
Up to 3″ pipe—screwed fittings	11	9
Larger than 3″ pipe—screwed fittings	19	13
All pipe sizes—flanged fittings	20	14



Rock Cork Pipe Insulation is easily and quickly applied

Preparation of Lines:

Before any insulation is applied, pipe and fittings must be tested, made tight, cleaned of rust, scale or other foreign matter, freed of frost and made dry.

All pipe should be hung on metal saddles placed over the insulation. A sheet metal shield, at least as long as the outside diameter of the insulation and extending half way up on each side, should be snugly fitted under the line at each hanger-point.

Lines may be supported on wood blocks set in hangers until the insulation is ready to be applied.

Rates of heat transmission

The rates of heat transmission given below are expressed in B.t.u. per square foot (and also per linear foot), per hour, per degree temperature difference between fluid in the pipe and air surrounding the pipe. In the case of screwed fittings, where the proportion of fittings to pipe is not unusually high, no great error will be introduced by figuring small fittings, such as ells and tees, as one linear foot of pipe; and larger fittings, valves, crosses, etc., as one and one-half linear feet. Reference to a table of areas will be necessary in computing radiation equivalents for flanged fittings. Such a table appears on another data sheet.

Pipe size, inches	Ice Water Thickness			Brine Thickness			Heavy Brine Thickness		
	B.t.u. per lin. ft.	B.t.u. per sq. ft. pipe surface	B.t.u. per sq. ft. outer surface	B.t.u. per lin. ft.	B.t.u. per sq. ft. pipe surface	B.t.u. per sq. ft. outer surface	B.t.u. per lin. ft.	B.t.u. per sq. ft. pipe surface	B.t.u. per sq. ft. outer surface
½	.110	.502	.105	.098	.446	.075	.087	.394	.051
¾	.119	.431	.101	.111	.405	.085	.094	.340	.051
1	.139	.403	.118	.124	.352	.086	.104	.294	.053
1¼	.155	.357	.118	.131	.300	.077	.113	.260	.054
1½	.174	.351	.133	.134	.270	.073	.118	.238	.053
2	.200	.322	.139	.151	.244	.077	.134	.214	.057
2½	.228	.303	.145	.170	.226	.081	.147	.197	.059
3	.269	.293	.158	.186	.202	.079	.162	.176	.059
3½	.295	.282	.161	.191	.183	.073	.176	.167	.061
4	.294	.248	.140	.209	.176	.076	.182	.154	.058
5	.349	.239	.148	.241	.165	.080	.202	.138	.057
6	.404	.233	.154	.259	.150	.076	.228	.130	.060
8	.455	.201	.139	.318	.140	.081	.263	.116	.059
10	.559	.198	.147	.383	.135	.086	.309	.110	.062
12	.648	.194	.150	.438	.131	.088	.364	.108	.067
14	.670	.182	.142	.487	.132	.093	.392	.107	.068
16	.750	.179	.143	.542	.130	.094	.434	.104	.069
18	.833	.176	.145	.604	.127	.096	.476	.102	.070
20	.919	.175	.146	.661	.126	.097	.520	.100	.071

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J-M Rock Cork Pipe Insulation, applied in 1931 to these outdoor refrigerated lines, is still in perfect condition in spite of weather exposure

Insulating the Pipe

Before Rock Cork insulation is applied, the pipe should be brushed with Zerogloss. The proper thickness of the insulation, according to the type of service, should then be applied to all straight sections of the line.

When the pipe is joined with flanged fittings, sections or segments should be applied about 1″ away from the flange to permit thorough packing of Zerotex between and around the bolts.

When screwed fittings have been used, the insulation should be butted tightly against the fitting. On some fittings, such as ells and tees, in certain sizes of pipe, the butting edges of the insulation may require beveling to secure correct application of the sections. A small space should be allowed between these edges so that the Zerotex may be tied in place on the fitting. Insulation applied in this manner reduces to a minimum the amount of time and material necessary to insulate fittings.

Sectional Pipe Insulation:

Before each section of insulation is applied, both longitudinal joints and one of the end joints, should be coated with J-M Zeroseal. Then the section should be placed upon the pipe, closed and temporarily secured with from four to eight staples furnished for the purpose, the coated end being butted tightly against the uncoated end of the previously applied section. The sections should be so placed that longitudinal joints occur at top and bottom of the pipe.

The area to be covered by the waterproof lap should then be coated with Zeroseal and the lap pressed smoothly into it. The end joint should next be sealed with one width of 3″ J-M Zerotape embedded in a coat of Zeroseal.

The section should be permanently secured in place with from three to six loops of copper-covered annealed steel wire or ½″ x .015″ galvanized steel straps. The smaller sizes of insulation should be secured with three straps or loops of wire. Larger

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sizes need a sufficient number to insure a tight, permanent installation. If wire is used, it should be twisted tightly and the ends neatly clipped.

Segmental Pipe Insulation:

When the insulation is furnished in segmental form, each segment is provided with a factory-applied jacket the lap of which extends along one longitudinal edge. When applied, this lap should cover the flush-cut edge of the jacket on the following segment. One longitudinal joint of each segment should be coated with Zeroseal and applied to the uncoated joint of the adjoining segment. When the complete set of segments is assembled on the pipe each area to be covered by a waterproof lap should be coated with Zeroseal and the lap pressed into it. The set is then strapped or wired in place with from three to six straps or loops of wire in the same manner as the sectional insulation.

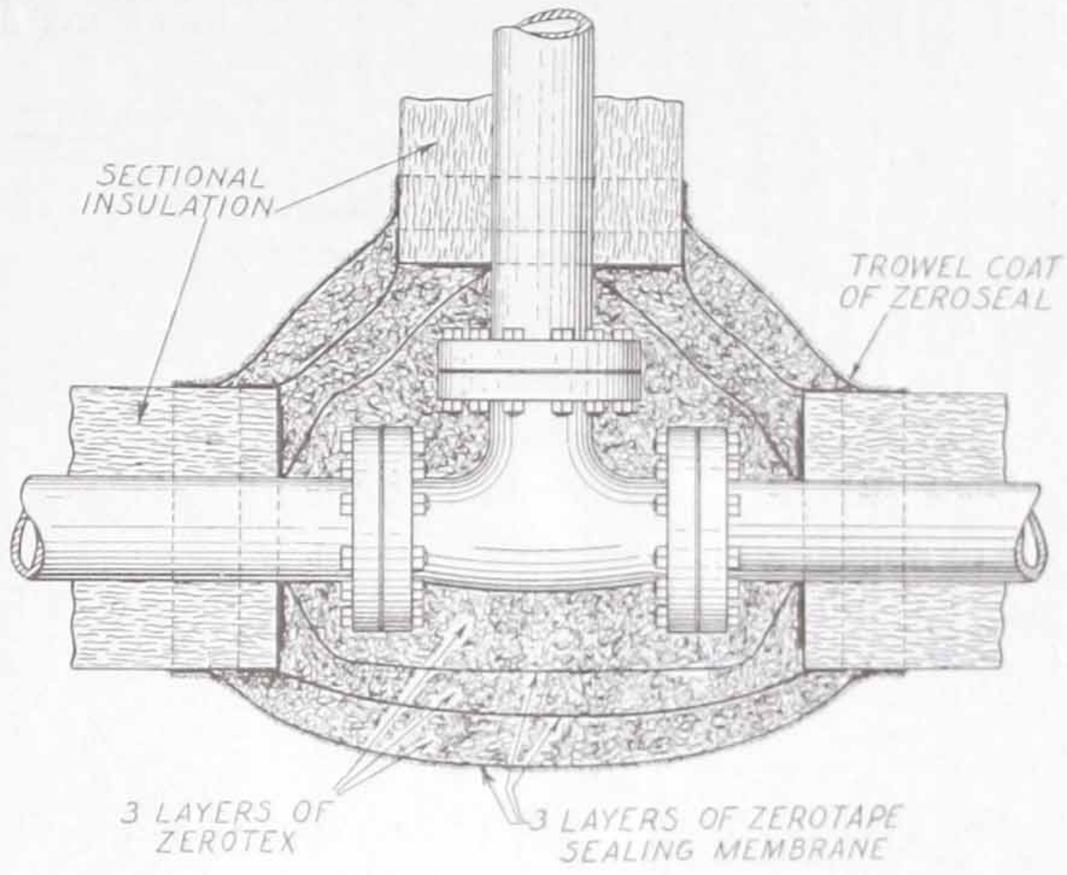
Lagging over Pipe Insulation:

When lagging is required over the insulation, a coat of Zeroseal should be applied and the lags embedded in it. They should then be secured with from three to six straps or loops of copper-annealed steel wire, the ends of wire being neatly clipped and bent down. See "Finishes" for final asbestos felt wrapping.

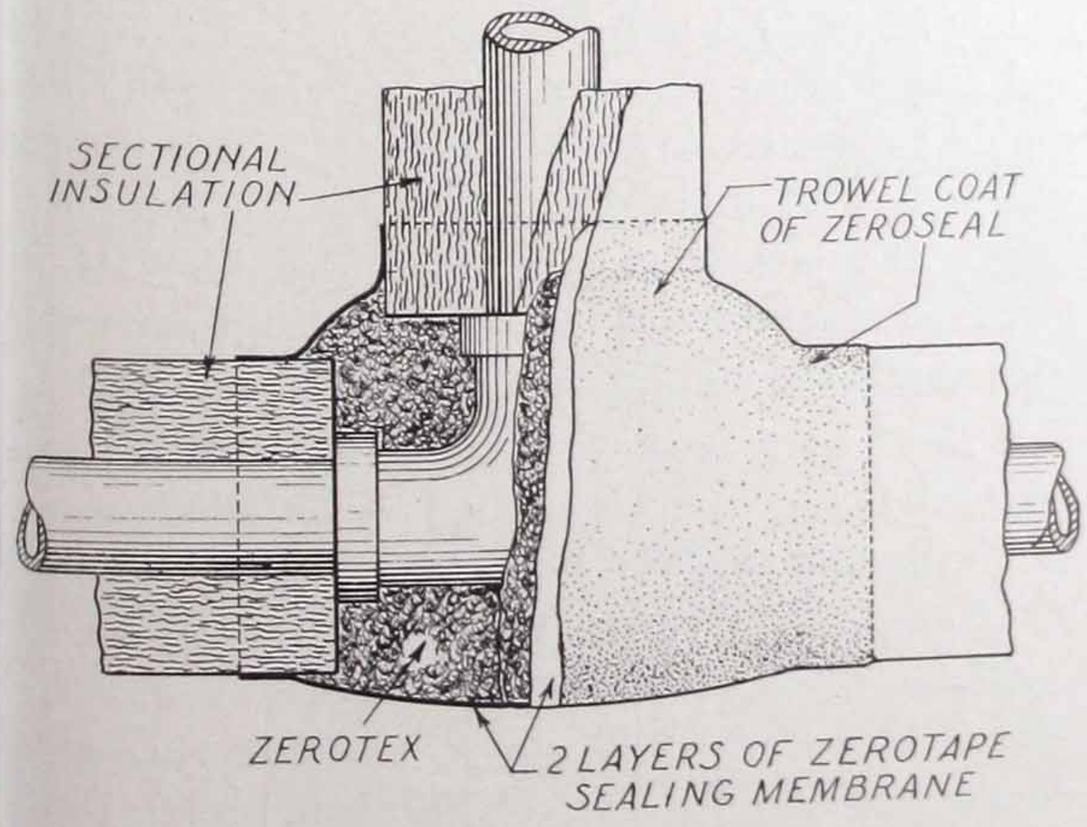
Insulating the Fittings

Before any fitting insulation is applied, care should be taken to see that the ends of the pipe insulation are coated with Zeroseal. The fitting should then be given a brush coat of Zerogloss.

All fittings are insulated with J-M Zerotex. Depending upon service requirements, from one to three built-up layers should be applied, each layer consisting of a sufficient number of plies to attain a compressed thickness of from 1½″ to 2″. As each ply is put on, it should be secured in place with several wraps of jute twine and the built-up layer covered with a double wrap of Zerotape. Before the application of each successive built-up layer, Zeroseal should be brushed into the Zerotape to close all pores and to facilitate the application of the next layer of Zerotex.



Fitting insulated for Heavy Brine thickness



Fitting insulated for Ice Water thickness

For Ice Water thickness, one layer of Zerotex, of slightly greater thickness than the pipe insulation, is required. The outer ply of Zerotex should be extended over the pipe insulation jacket about 1″.

Brine thickness requires two layers of Zerotex, the first of which should be built up to about one-half the thickness of the adjoining pipe insulation. When the second layer is applied, the total thickness should be slightly greater than the pipe insulation and the outer ply of Zerotex should extend about 1″ over it.

When Heavy Brine thickness is used, three layers of Zerotex are required. The first two should be applied as described for Brine thickness and the third layer applied over them. The third layer should extend about 2″ over the adjacent pipe insulation.

If lagging is used over Heavy Brine thickness, fittings should be insulated as described for Heavy Brine thickness, so that the total thickness of the fitting insulation exceeds that of the pipe insulation by at least 2″.

Each built-up layer of Zerotex should be evenly and symmetrically packed around the fitting and care exercised to see that flanges receive the full thickness.

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The sealing membrane covering each layer of Zerotex should consist of a wrap of Zerotape applied so that a double thickness of the tape covers the Zerotex at every point. Over each sealing membrane, Zeroseal should be applied, leaving no uncoated spots.

The ends of the Zerotape in each case should be sealed to the pipe insulation with Zeroseal.

On larger fittings, 4″ and up, considerable tape can be saved by tying over the Zerotex a layer of J-M 15-lb. Asbestos Waterproofing Felt to afford a smooth base for the application of the tape.

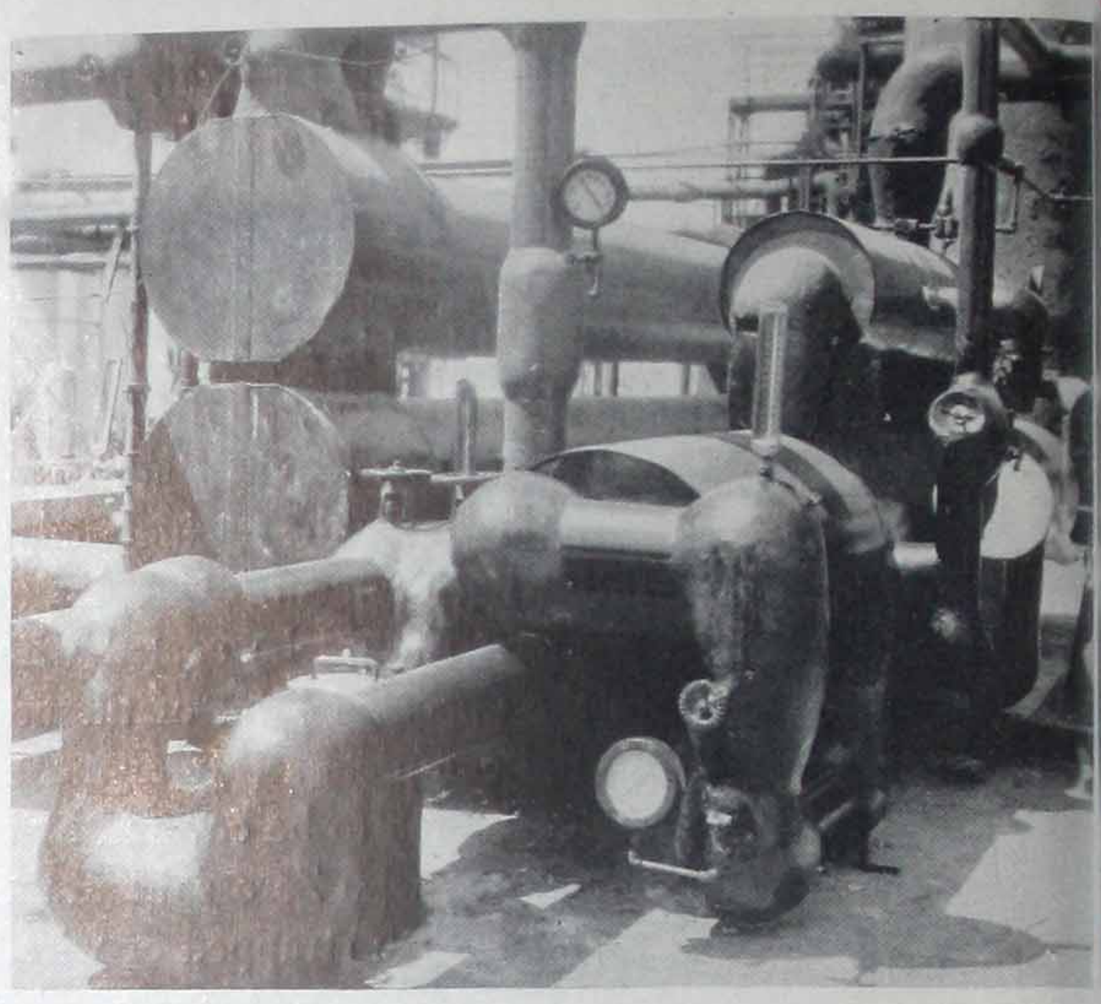
After the full thickness of the Zerotex has been applied and sealed, the entire surface of the fitting should be covered with a trowel coat of Zeroseal. A ¼″ coat of hard-finish asbestos cement, consisting of 2 parts of asbestos cement and 1 part of portland cement, should then be troweled smoothly over the insulated fitting. On fittings in concealed locations and where appearance is unimportant, the cement coating may be omitted without loss of insulating value as it is applied only to provide a smooth finish.

Finishes

For a bright, black finish, a brush coat of J-M Zerogloss is recommended over all pipe insulation and fittings. If an aluminum finish is desired, the following mixture is applied over the Zerogloss.

To 2 lb. of the Aluminum Company of America's Extra Brilliant Varnish Powder add one gallon of Du Pont Company's RC 129 Aluminum Mixing Varnish. The paint must be mixed immediately before using and in no case should more paint be made up than can be used in one day. Two coats should be applied, the first of which must be allowed to dry at least 24 hours before the second coat is applied. A brush may be used for application, but a spray will give a quicker and possibly slightly smoother job.

Applying the sealing membrane over Zerotex



The finished Rock Cork job, perfectly sealed to prevent frosting, offers a neat and workmanlike appearance

When lags are applied over the pipe insulation, their outside surface should be coated with J-M Zeroseal, and the line then wrapped with J-M No. 50 Waterproofing Felt. Where hot asphalt can be used economically, it should be used, instead of Zeroseal, to hot-mop the felt in place. The entire line is then finished with a brush coat of Zerogloss.

For weatherproofing, insulation on all outdoor lines should be further protected with an additional jacket of J-M Double Coated Flexstone which is furnished in rolls of 108 sq. ft., 32″ wide, and weighing approximately 55 lb. All joints should be lapped at least 3″ and sealed down with Zeroseal. All horizontal laps should be located on the side of the pipe with the laps turned downward in order to shed water from the surface. The jackets should be secured in place by means of rings of No. 16 B. & S. gauge Copperweld wire applied at not greater than 4″ centers.

If fire hazard must be considered, a J-M Asbestos Firetard Jacket may be applied in the same manner as the Double Coated Flexstone. Furnished in rolls of 108 sq. ft., 32″ wide, and weighing about 50 lb.

Zerotex Fitting Insulation, properly sealed and coated in accord with the application directions, should receive a ¼″ coat of Insulkote troweled to a smooth finish when the line is exposed to the weather.

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J-M Built-up Brine and Ammonia Insulation

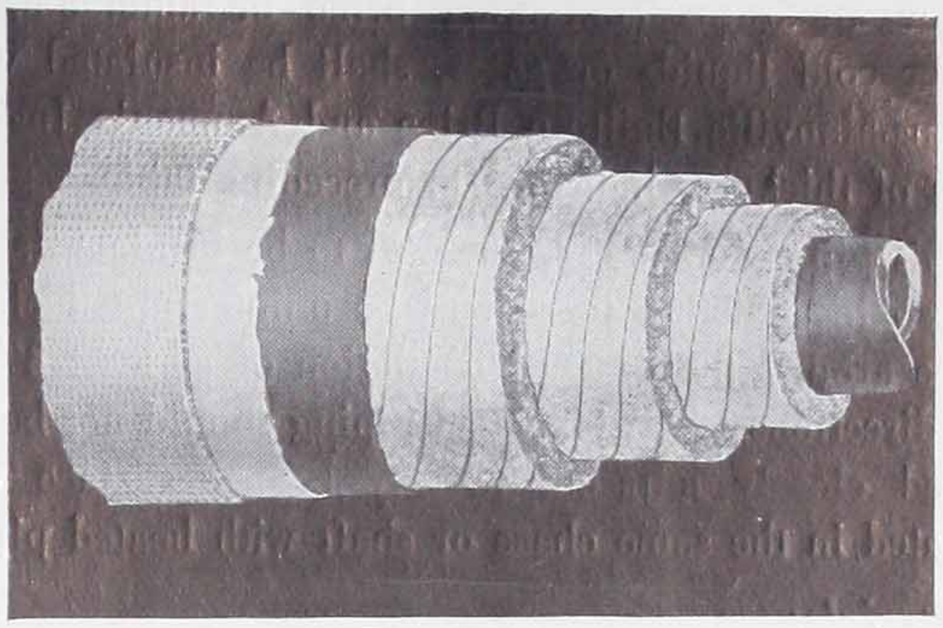
J-M Built-up Brine and Ammonia Insulation is efficient in maintaining the extremely low temperatures required in pipe lines conveying brine, ammonia or other cold liquids or gases. It consists of several layers of insulating felts carefully applied and sealed around pipes to be insulated.

The effective method of sealing eliminates the possibility of moisture accumulating between pipe and insulation and then freezing and bursting the insulation.

J-M Built-up Brine and Ammonia Insulation is not only highly efficient as an insulator, but will withstand contraction and expansion without cracking or breaking open.

This type of built-up insulation to be satisfactory should be applied only by mechanics specially trained in low temperature work. Johns-Manville Approved Contractors are experienced in applying these materials.

Insulation should be of a suitable thickness, based on temperatures contained in piping or apparatus.



The ordinary range of temperatures requires the following thicknesses:

Plus 30°F.	to plus 15°F.	— 2″	insulation
Plus 15°F.	to minus 5°F.	— 3″	insulation
Minus 5°F.	to minus 20°F.	— 4″	insulation
Minus 20°F.	to minus 40°F.	— 5″*	insulation
Minus 40°F.	to minus 60°F.	— 6″*	insulation

*For pipes smaller than 3½″ at temperatures from minus 20 to minus 60 deg. F., deduct 1″ insulation.

Where temperatures are below minus 60 deg. F., recommendations will be furnished by Johns-Manville.

Rates of heat transmission

The rates of heat transmission given below are expressed in B.t.u. per square foot (and also per linear foot) of pipe surface, per hour, per degree temperature difference between fluid in the pipe and air surrounding the pipe. The thickness of 2-layer has been taken as 2″, of 3-layer as 3″ and 4-layer as 4″. Sometimes the thicknesses after application are less than these nominal thicknesses and for such cases the figures in the table should be modified accordingly.

Pipe size, inches	2″ Insulation		3″ Insulation		4″ Insulation		5″ Insulation		6″ Insulation	
	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.
½	.086	.390	.074	.331	.065	.295	....	....	....	....
¾	.095	.345	.079	.288	.070	.255	.069	.252	....	....
1	.107	.310	.088	.257	.078	.227	.072	.210	....	....
1¼	.124	.285	.102	.235	.090	.206	.080	.183	....	....
1½	.132	.265	.109	.218	.095	.190	.085	.170	.078	.157
2	.149	.240	.120	.193	.104	.167	.094	.151	.086	.139
2½	.167	.222	.133	.177	.114	.151	.107	.141	.095	.126
3	.192	.210	.148	.162	.128	.140	.114	.125	.104	.114
3½	.211	.201	.165	.157	.138	.132	.124	.119	.112	.107
4	.228	.194	.176	.150	.148	.126	.132	.112	.120	.101
4½	.247	.188	.190	.145	.158	.121	.142	.108	.127	.097
5	.268	.184	.205	.141	.170	.117	.151	.103	.135	.092
6	.307	.177	.233	.134	.191	.111	.164	.097	.149	.087
7	.343	.172	.257	.129	.212	.106	.184	.092	.164	.082
8	.380	.168	.282	.125	.232	.102	.200	.089	.178	.079
9	.415	.165	.307	.122	.242	.099	.220	.087	.191	.076
10	.455	.162	.335	.119	.279	.097	.234	.083	.206	.073
12	.528	.158	.387	.116	.310	.093	.268	.080	.234	.070

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Built-up Brine and Ammonia Insulation Specification

All pipe lines, including fittings and flanges and other apparatus containing brine or ammonia, or other cold liquids or gases, shall be insulated with Johns-Manville Built-up Brine and Ammonia Insulation of thickness indicated in preceding table.

All piping and other surfaces to be insulated shall be so located that there will be uninterrupted clearance around the finished insulation of at least 3″ in all directions. The insulated piping should not be located closely adjacent to any heated surface nor located in the same chase or shaft with heated pipes.

Materials:

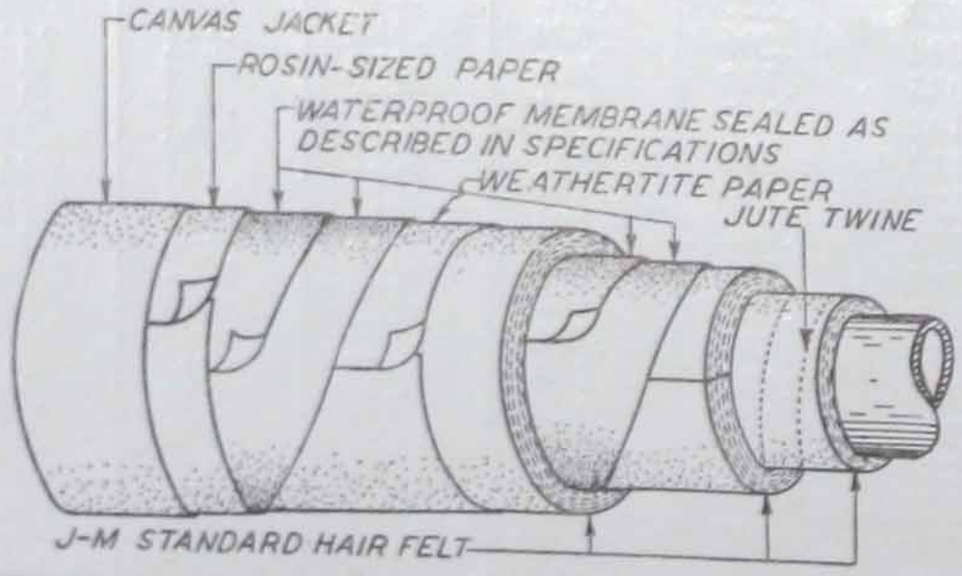
Hair Felt insulation shall be 100% pure cattle hair, lime-washed and free of foreign matter, weighing not less than 11 oz. per sq. ft., 1″ thick.

Waterproof membrane shall consist of J-M Brine and Ammonia Sealing Tape,* wound on spirally so that at no point is there less than two plies, and covered with two coats of J-M Brine and Ammonia Sealing Compound.** No uncoated spots shall be left.

Pipes:

All surfaces shall be thoroughly cleaned and dried before insulation is applied and the system shall not be put in operation until work is completed.

Whenever it is desired to seal the end of the insulation, as at fittings, valves, flanges, etc., the bare pipe for a distance of about 1 linear foot is wrapped with the waterproof membrane, applied as described under "Materials." All pipes shall then be wrapped with a layer of 1″ Hair Felt, cut to proper length, so that all longitudinal and abutting joints shall fit closely together. The Hair Felt shall be secured to the pipe by 2-ply wrapping twine, wound spirally on approximate 1″ centers. Then additional layers of 1″ Hair Felt shall be applied, to the thickness specified, with all joints broken.



Two-inch insulation shall have a waterproof membrane applied on the outer surface as described under "Materials." Three, four and five-inch insulation shall have two membranes, one over each of the two outer layers. Insulation thicker than 5″ shall have three membranes covering the last three layers of felt. The outer layer in each case, regardless of thickness of insulation, shall be reinforced with a layer of standard weight J-M Weathertite Paper under the membrane. On valves and fittings where it is not practical to apply the paper, an extra wrapping of tape shall be put on.

Fittings:

Wherever the pipe is interrupted by fittings, etc., insulation shall be sealed off by carrying membrane down to the pipe and sealing thereto.

All fittings shall be insulated separately from the adjacent piping, the insulation being of the same thickness, and applied and sealed in the same manner as on the pipe.

Where pipe and fitting insulation meet there shall be a full thickness of insulation, and membranes of fitting insulation shall be well sealed to the outer membrane of pipe insulation.

Hangers:

Each hanger shall be insulated separately, the same as the fittings, running the insulation along the rod of the hanger for not less than 12″ beyond the adjacent pipe insulation.

Accumulators, Tanks, etc.:

Surfaces of accumulators, tanks, etc., shall be insulated as specified above for pipe lines, except that *extra thicknesses* of insulation felts may be required on account of lower temperatures.

Finish of Insulation:

All insulation exposed to view shall be finished with 8-oz. canvas, sewed on over a layer of rosin sized sheathing paper, then thoroughly sized, and painted with not less than two coats of a first quality lead and oil paint, of color selected by purchaser.

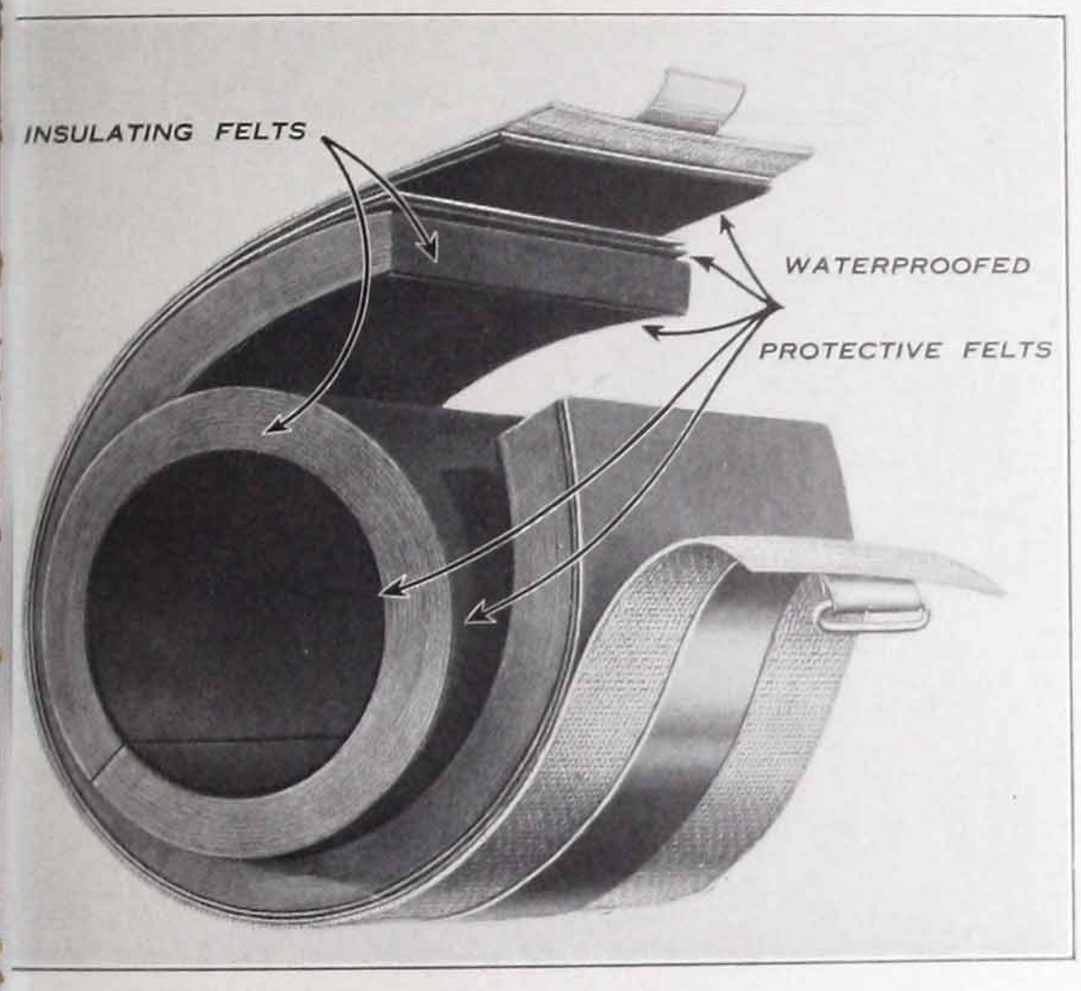
All insulation shall be applied by the manufacturer of the materials, or by his approved contractor.

*A waterproof fabric furnished in 40-ft. rolls from 1½″ to 6″ wide in ½″ increments.
**A liquid asphaltic compound furnished in 1, 3, 5, 25 and 50-gal. containers.

Printed in U.S.A.

Anti-Sweat Pipe Insulation

J-M Anti-Sweat is a cold water pipe insulation used ot only to keep the water cold but to prevent condention and damage from dripping. The insulation has rticular application in such locations as weave ooms of textile mills, pickle rooms of packing plants, rious locations in paper mills and in other places here sweating pipes would present difficulties and e ever-present possibility of serious water damage.



J-M Anti-Sweat, a strong, resilient and durable product, is the logical material for use where the insulation may be exposed to impact or shock.

Anti-Sweat is made of pre-shrunk insulating felts and waterpoofing felts. The waterproofing felts, on the inner and outer surfaces of each layer, protect the insulation from the infiltration of moisture. The broken-joint construction, furnished in thicknesses of 1″ and over, eliminates through joints. When this construction is applied, the outer layer is turned and slipped along so that all joints are staggered.

This material, in proper thickness, is suitable for the entire range of cold and ice water service. The required thickness depends upon temperature and humidity of surrounding air in relation to the tem-

Approximate weight in pounds per 3-foot section, uncrated

Thickness, inches	Nominal pipe sizes, inches							
	4½	5	6	7	8	9	10	12
¾	9.87	10.75	12.47	14.00	15.60	17.25	19.00	22.15
1	11.95	13.00	15.05	16.93	18.85	20.70	22.80	26.60
1½	18.60	20.00	22.80	25.27	27.95	30.60	33.40	38.60

Carton contents and approximate weights

Cartons, 14″ x 20½″ x 36¾″ O.D.	½″ thick			¾″ thick			1″ thick		
Nominal pipe size	Feet	No. of sections	Approx. gross wgt. lb.	Feet	No. of sections	Approx. gross wgt. lb.	Feet	No. of sections	Approx. gross wgt. lb.
½ inch	162	54	93	108	36	101	72	24	108
¾ inch	135	45	86	99	33	92	66	22	96
1 inch	108	36	83	84	28	94	60	20	98
1¼ inches	84	28	76	66	22	84	48	16	92
1½ inches	75	25	71	60	20	79	45	15	88
2 inches	54	18	72	45	15	73	36	12	89
2½ inches	39	13	57	36	12	72	27	9	79
3 inches	33	11	53	27	9	60	21	7	70
4 inches				18	6	56	18	6	72

Rates of Heat Transmission

B.t.u. per hour, per degree temperature difference, per linear foot and per square foot of pipe surface.

Insulation	½″ thick		¾″ thick		1″ thick		1½″ thick		2″ thick	
Pipe size, inches	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.	B.t.u. per lin. ft.	B.t.u. per sq. ft.
½	.212	.963	.185	.841	.167	.758	.143	.649	.128	.581
¾	.245	.891	.212	.770	.189	.687	.160	.581	.142	.515
1	.286	.830	.243	.706	.215	.625	.180	.523	.158	.460
1¼	.338	.777	.284	.653	.249	.572	.206	.473	.180	.413
1½	.374	.751	.312	.627	.272	.546	.223	.448	.194	.389
2	.443	.713	.367	.591	.318	.512	.257	.413	.221	.356
2½	.518	.688	.425	.564	.364	.484	.292	.388	.249	.331
3	.611	.666	.497	.542	.423	.462	.337	.367	.284	.310
3½	.685	.655	.553	.528	.468	.447	.369	.353	.311	.297
4	.757	.643	.611	.518	.515	.437	.404	.343	.338	.287

ANTI-SWEAT PIPE INSULATION
June, 1937 (Cancelling sheet dated November, 1936)

Printed in U. S. A.

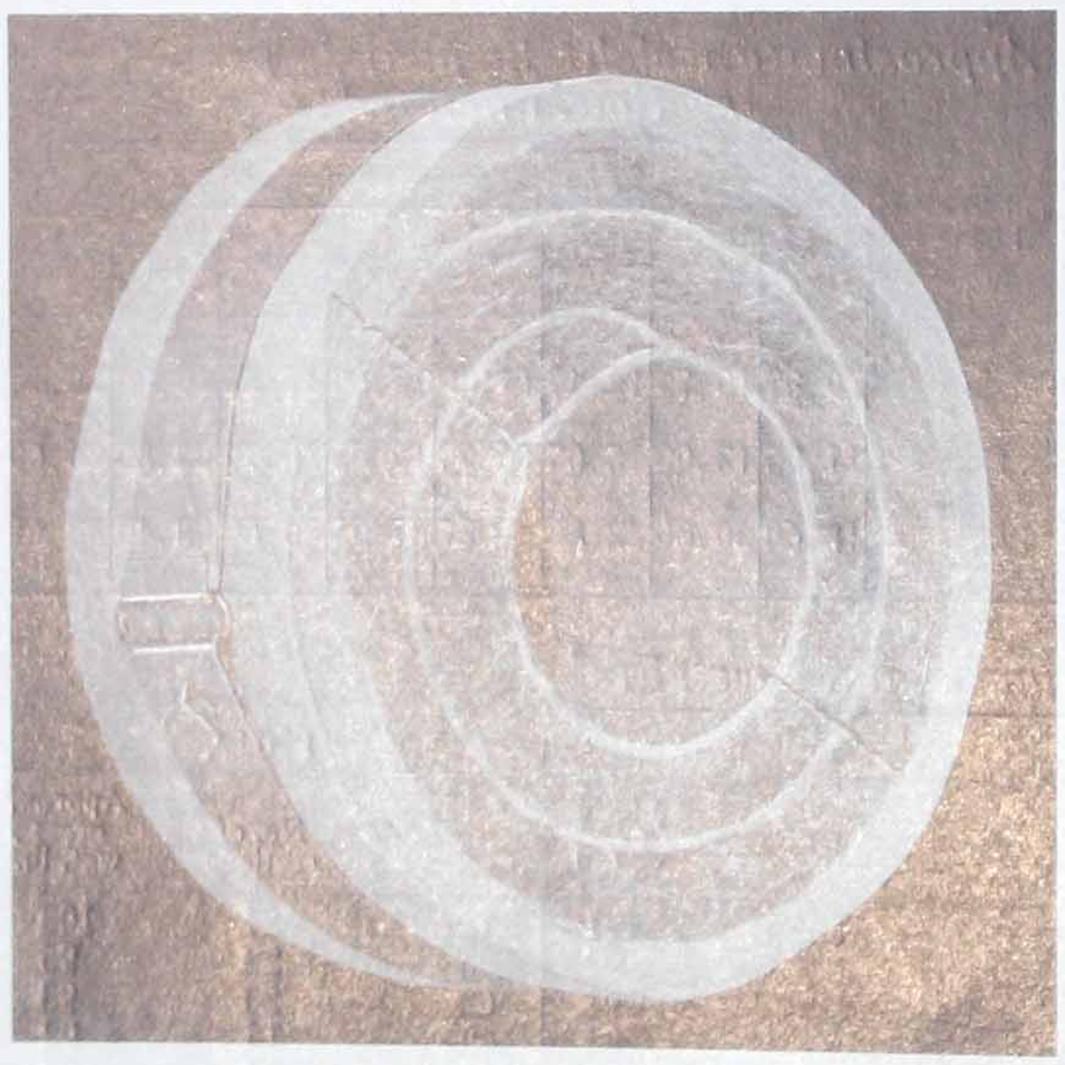
perature of the pipe. On pipes with temperatures over 50 deg.F., 1″ of insulation is used if relativity humidity is less than 75 percent; if humidity ranges from 75 to 80 percent, the 1½″ thickness is used. For temperatures between 32 and 50 deg.F., if relative humidity is under 75 percent, the 1½″ thickness is used. Recommendations for other conditions can be secured from Johns-Manville.

The longitudinal laps of Anti-Sweat are sealed with Laptite,* applied directly over the cut, using just enough to prevent the cement from squeezing out. As with all cold insulation installations, careful sealing of all joints is essential to prevent the entrance of moisture vapor into the insulation.

Fittings are insulated with J-M Standard Hair Felt, of a thickness similar to adjacent insulation. The Hair Felt is sealed with a double wrap of J-M Sealing Tape** and a coat of J-M Sealing Compound***. For mild conditions, a ¼″ Asbestos Cement finish may be used instead of the fabric and compound.

Anti-Sweat is made in 3-ft. sections, in thicknesses of ½″ and ¾″, solid construction, and in 1″, 1½″ and 2″ thicknesses, double layer construction, to fit standard pipe sizes and straight runs of copper tubing of the following outside diameters: ⅜″, ½″, ⅝″, ⅞″, 1⅛″, 1⅜″, 1⅝″, 2⅛″, 2⅝″, 3⅛″, 3⅝″, 4⅛″, 5⅛″ and 6⅛″. Sizes to and including 4″ are shipped in cartons; larger sizes are crated.

Zero Pipe Insulation



Zero Pipe Insulation is used to prevent cold water pipes from freezing under *ordinary* conditions.

It is designed for insulating cold water pipes that are exposed to moderate rather than extremely low temperatures or where the time that the surrounding air would be below freezing point is of short duration.

Zero Pipe Insulation is constructed of layers of hair felt surrounded by several layers of wool felt, with a layer of saturated wool felt inside the hair felt to keep the hair from direct contact with the pipe.

Hair felt, one of the best of insulating materials, greatly retards the flow of heat from the water in the pipe to the colder surrounding air, and the wool felt jacket and the inner layer of saturated felt provide efficient protection for the hair felt.

When this material is applied to pipes running out-of-doors, special provision should be made for a separate jacket of Double Coated Flexstone.

For extremely low temperatures or for temperatures below the freezing point that are of long duration, J-M Built-up Hairfelt is recommended, applied in various thicknesses depending upon the temperature.

Zero Pipe Insulation is furnished in 3-foot lengths, split for ready application, covered with canvas and equipped with brass lacquered bands. Made for all pipe sizes from ½″ up, and in *one* thickness, approximately 1¼″.

In addition to regular pipe sizes, sections of Zero are manufactured to fit straight runs of copper pipe and tubing of the following outside diameters: ⅜″, ½″, ⅝″, ⅞″, 1⅛″, 1⅜″, 1⅝″, 2⅛″, 2⅝″, 3⅛″, 3⅝″, 4⅛″, 5⅛″ and 6⅛″.

Carton contents and shipping weights

Nominal pipe size	Feet	Sections	Approx. gross weight, lb.
½ inch	60	20	78
¾ inch	54	18	85
1 inch	45	15	65
1¼ inches	39	13	65
1½ inches	36	12	71
2 inches	30	10	69
2½ inches	21	7	61
3 inches	18	6	50
4 inches	12	4	41

Carton size: 14″ x 20½″ x 36¾″

* Laptite, an asphaltic cement furnished in ½, 1, 5, 25 and 50-gal. containers. ** J-M Brine and Ammonia Sealing Tape, a waterproof fabric furnished in 40-ft. rolls from 1½″ to 6″ wide in ½″ increments. ***J-M Brine and Ammonia Sealing Compound, a liquid asphaltic compound furnished in 1, 3, 5, 25 and 50-gal. containers.

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J-M Built-up Hair Felt Pipe Insulation

J-M Built-up Hair Felt Insulation is designed to protect pipes from freezing wherever they are subjected to severe conditions. This insulation consists of a suitable number of layers of 1″ J-M Standard Hair Felt securely bound in place on the pipe by means of heavy jute twine and finished on the outside with a waterproof jacket.

It is not possible to give a definite recommendation as to thickness which would suitably protect pipes under all conditions. No insulation, no matter how thick or efficient it may be, will prevent freezing where there is no circulation or only a small amount of circulation in the pipes, if the outside temperature remains low for a sufficient length of time.

Insulation will retard freezing, and if there is a certain amount of circulation or, even without circulation, if the air remains at a low temperature for a short enough period, freezing may be prevented.

To make a specific recommendation, the following information is required:

1. Minimum temperature to which pipe will be exposed.
2. Duration of this extreme temperature.
3. Temperature of fluid entering the pipe.
4. Size of pipe.
5. Length of exposed section of pipe.
6. Rate of flow through pipe.
7. Duration of periods, if any, when there will be no flow.

Following are the rates of heat transmission through 2-layer, 3-layer and 4-layer Built-up Hair Felt Insulation on pipes from ½″ to 12″ in diameter.

Also, to assist in quick estimates as to results which may be accomplished, figures are tabulated showing the length of time necessary for water in a pipe to be cooled 10 deg., from 42 to 32 deg. F., with a difference in temperature between water and air of 60 deg. F., which would correspond to an air temperature of about 20 deg. F. below zero.

Water should not be allowed to remain stationary for longer than one-half the time mentioned.

The last column indicates the minimum amount of water which should be supplied per hour at 42 deg. F. for each linear foot of pipe, in order to prevent the temperature of the water from being lowered to the freezing point. The weight in this column should be multiplied by the length of the pipe in feet. In order to provide against temporary reduction of flow due to lower pressure, etc., the rate of flow should be at least double that given in table. The figures on time and flow apply only to the conditions given.

If the water enters the pipe at 52 deg. F., instead of 42 deg. F., it will take double the time given in order to cool it to the freezing point, or only half the amount of water need be circulated.

Data on Freezing of Water in Pipes*

Pipe size, inches	Insulation, No. of layers each 1 in. thick	B. t. u. per deg. temp. diff., per hour per lin. ft.	Hours to cool to freezing point	Lb. water flow per hr. per lin. ft. to prevent freezing
½	2	.0895	.417	.537
	3	.0747	.500	.448
	4	.0660	.565	.396
1	2	.1125	.825	.675
	3	.0911	1.02	.548
	4	.0798	1.16	.480
1½	2	.1400	1.40	.840
	3	.1126	1.74	.676
	4	.0972	2.02	.583
2	2	.1586	1.94	.952
	3	.1244	2.48	.747
	4	.1063	2.90	.638
3	2	.2062	3.25	1.237
	3	.1572	4.27	.943
	4	.1322	5.08	.793
4	2	.2450	4.55	1.470
	3	.1850	6.02	1.110
	4	.1548	7.20	.929
5	2	.2887	5.92	1.733
	3	.2146	7.96	1.289
	4	.1764	9.69	1.059
6	2	.3302	7.35	1.981
	3	.2434	9.88	1.460
	4	.1984	12.20	1.191
8	2	.4100	10.05	2.460
	3	.2960	13.90	1.776
	4	.2390	17.25	1.434
10	2	.4930	13.00	2.960
	3	.3536	18.10	2.122
	4	.2830	22.70	1.698
12	2	.5720	15.80	3.432
	3	.4090	22.20	2.454
	4	.3222	28.10	1.933

*In the above figures, the effect of varying temperature difference due to cooling of the water has been ignored, as this is an unnecessary refinement where large factors of safety are required. The only effect of not considering this varying temperature difference is to increase the factor of safety.

The time shown in the table is the time to lower the water to the freezing point. Much longer time would be required actually to freeze all of the water in the pipes, but once it starts to freeze, the danger point has been reached. If the water were to freeze at only one point, flow would be stopped and the whole line be in danger.

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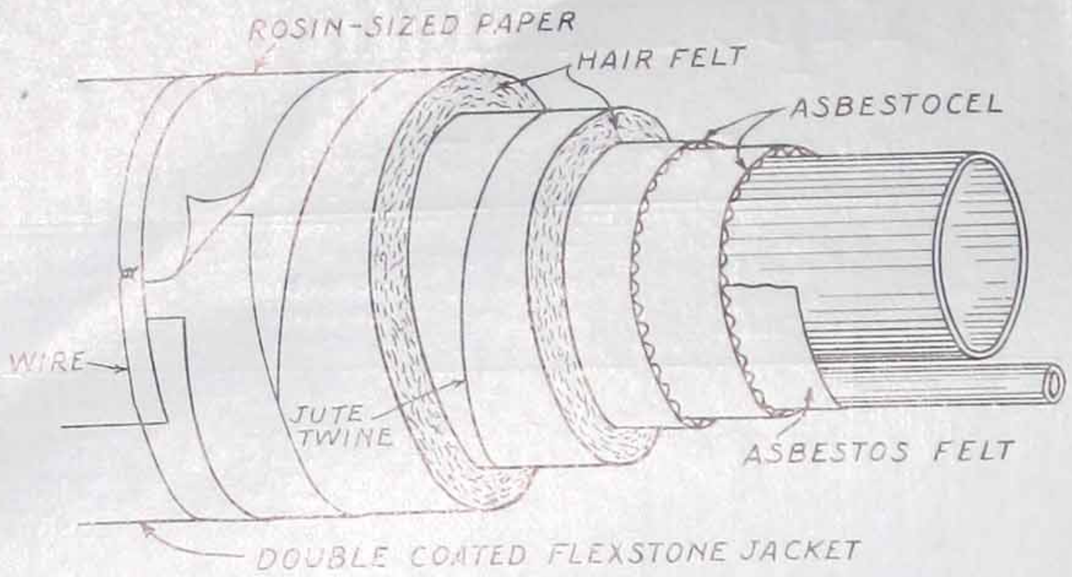


Insulation for standpipes with adjacent steam lines

On the other hand, if it enters at 34 deg. F., it will be cooled to 32 deg. F. in one-fifth of the time given or five times as much water would be required.

If the minimum temperature is about 40 deg. F. below zero (temperature difference equals 80 deg. F.), instead of 20 deg. F., the time required to cool water to the freezing point will be 60/80 times that given in the table, or the amount of flow required will be 80/60 times that given in the table.

Where water must remain stationary longer than the safe length of time previously indicated, the only sure way of protecting the line is to provide a small steam or hot water line alongside the water line and then place insulation entirely around both lines.

Specification to Prevent Freezing

All cold water, compressed air, soil and waste piping and fittings that are exposed to freezing temperatures, shall be insulated with J-M Built-Up Hair Felt Insulation of the required number of layers. Each layer of J-M Standard Hair Felt shall be 1″ thick and secured to the pipe with a wrapping of heavy jute twine on 2″ centers, and over each layer shall be applied a layer of 15-lb. Asphalt Felt, secured in place with a wrapping of jute twine.

If no weather-proof or canvas jacket is to be applied, the Asphalt Felt at the outside of the insulation shall be sealed at both circumferential and longitudinal joints with J-M Laptite.*

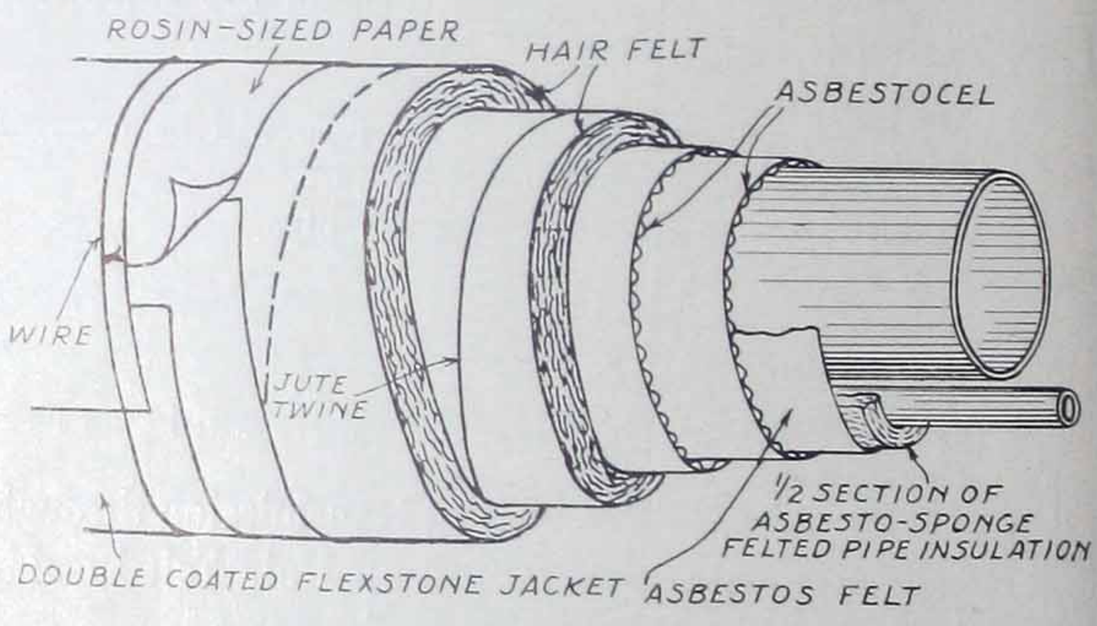
All pipe and fitting insulation exposed to view shall be enclosed in a jacket of 8-oz. canvas, sewed over linings of oiled paper and of heavy rosin-sized paper. Seams shall be located where least visible.

All insulation with a canvas finish exposed to view shall be painted with first a heavy coat of glue sizing and then with two coats of first quality white lead and linseed oil paint of the desired color.

If piping is exposed to the weather, the canvas shall be omitted and in its place the insulation shall be protected by a Double Coated Flexstone Weather-proof Jacket, with all joints lapped at least 3″ and sealed with Laptite.* The jacket shall be secured with rings of No. 16 B & S gauge Copperweld wire applied on 4″ centers. Laps on horizontal pipe shall be placed on the side and turned downward to shed water.

Standpipes:

Standpipes or other water pipes in which water may not circulate for several hours shall be protected by means of a small diameter low-pressure steam line running adjacent to the water pipe. The two pipes shall then be insulated together with an inclusive covering of one layer of J-M 8-lb. Asbestos Felt; two layers of 1-ply Asbestocel, in flexible roll form; and two layers of Built-up Hair Felt Insulation, each layer being secured in place with heavy jute twine. Finish over the insulation shall be provided as specified in the foregoing paragraphs.



Insulation for hot oil lines with adjacent steam pipes

Hot oil lines:

Hot oil, tar lines, etc., in which it is necessary to maintain a temperature sufficiently high to insure proper flow, shall be protected from cooling by means of a small high-pressure steam pipe running adjacent to the main pipe. The two pipes shall then be insulated as follows: A half-section of 1″-thick J-M Asbestos-Sponge Felted Pipe Insulation shall be wired over the small pipe on the side opposite to the main pipe and followed by one layer of J-M 8-lb. Asbestos Felt, two layers of 1-ply Asbestocel and two layers of J-M Built-up Hair Felt Insulation, each layer being secured with heavy jute twine. Finish over the insulation shall be provided as specified above.

*Laptite is an asphaltic cement, furnished in ½, 1, 5, 25 and 50-gal. containers.

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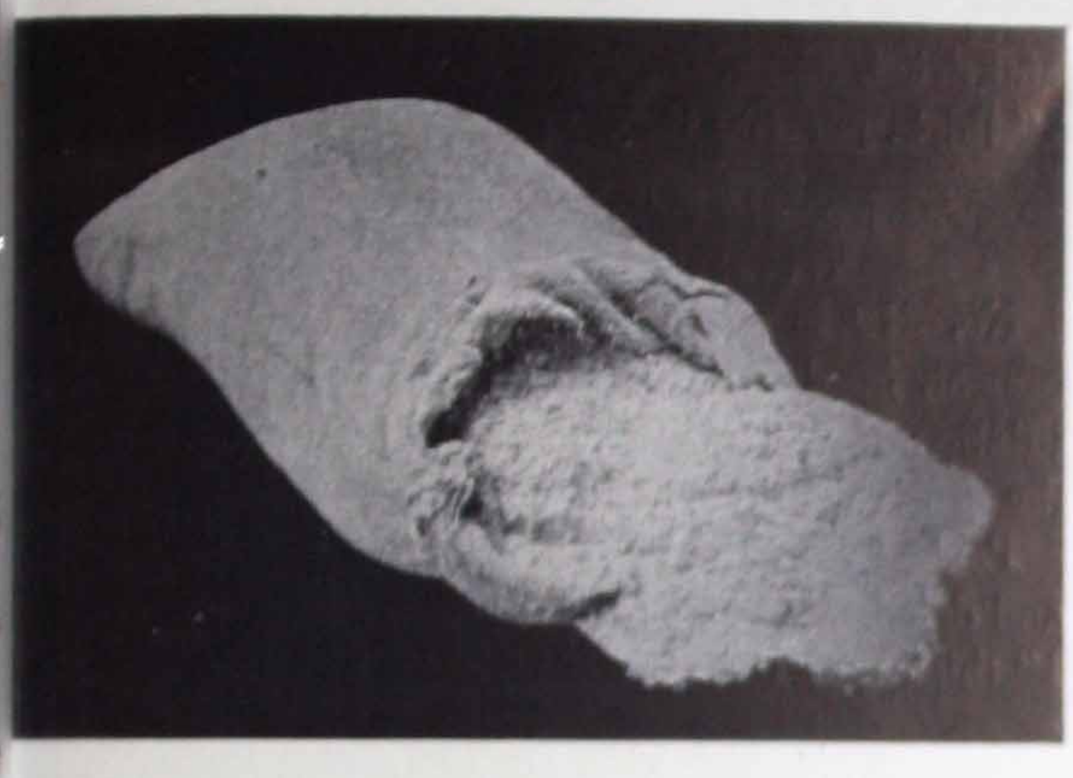
J-M Insulating Cements



J-M Insulating Cements are well known for their excellent coverage, good finish and insulating properties. There is a cement for every purpose.

Asbestos insulating cements are generally used as a surface finish over block or sheet forms of insulation to seal all joints between the blocks and to provide a smooth, attractive finish or a surface to which canvas may be applied if desired.

J-M Insulating Cements are also especially suitable for insulating irregular surfaces such as valves, flanges and other pipe fittings, heating furnaces, kettles, etc., where it would be impracticable to apply sectional insulation, sheets or blocks.

No. 302 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 302 Cement is made of asbestos fibre and binding materials. It is a high-grade insulating cement, easy to mix and apply, and sticks readily to hot surfaces.

It is an excellent finishing cement, producing a hard, durable and attractive surface which does not crack, break or peel off.

Packed in 100-lb. bags. Covering capacity, applied and dried, 25 sq. ft., 1″ thick, per bag.

No. 500 Insulating Cement
(For temperatures to 1500 deg. F.)

No. 500 is an expanded vermiculite base cement. It has exceptionally high covering capacity, combined with good working qualities and insulating value. It has good adhesion and can be applied in thick coats to irregular surfaces on which block and sheet insulation are not adaptable.

After use at 1500 deg. F., it is capable of being taken off, mixed a second time and reapplied, with no appreciable decrease in its original properties of adhesion, ease of troweling or plasticity. It may be used to 1800 deg. F., if reapplication is not required.

Packed in 50-lb. containers. Covering capacity, applied and dried, 39 sq. ft., 1″ thick per container; or 78 sq. ft., 1″ thick, per 100 lb.

No. 450 Insulating Cement
(For temperatures to 1200 deg. F.)

No. 450 is a mineral wool base cement with good covering capacity and excellent adhesion to both hot and cold surfaces. It is a very good insulator compared with other cements. Its excellent adhesion permits it to be readily applied in thick layers to surfaces too irregular to insulate with sheet and block forms.

After being in service at temperatures to 1200 deg. F., it can be removed, readily remixed and reapplied without appreciable loss of its original working properties such as plasticity, adhesion and ease of troweling. Where reapplication is not essential, it may be used to 1500 deg. F.

Packed in 50-lb. bags. Covering capacity, applied and dried, 25 sq. ft., 1″ thick per bag; or 50 sq. ft., 1″ thick, per 100 lb.

No. 0352 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 0352 Cement is an inexpensive cement used in large quantities by the steamfitting and plumbing trade for insulating heating boilers and pipe fittings.

Packed in 100-lb. bags. Covering capacity, applied and dried, 19 sq. ft., 1″ thick, per bag.

No. 352 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 352 Cement is the general utility short fibre cement, used for many years where a cement with asbestos of minimum length is satisfactory.

Packed in 50-lb. paper and 100-lb. burlap bags. Covering capacity, applied and dried, 19 sq. ft., 1″ thick, per 100 lb.

No. 340 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 340 Cement is a high grade material, comparing favorably with No. 302 Cement but having a somewhat smaller covering capacity and lower cost.

Packed in 100-lb. bags. Covering capacity, applied and dried, 18 sq. ft., 1″ thick, per bag.

No. 304 Hot Blast Cement
(For temperatures to 1200 deg. F.)

No. 304 Hot Blast Cement is a semi-refractory insulating cement which provides an excellent finish and is frequently used for fireproofing structural steel.

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Packed in 100-lb. bags. Covering capacity, applied and dried, 18 sq. ft., 1″ thick, per bag.

No. 364 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 364 Cement is an excellent medium-grade cement frequently used by the steamfitting trade. It adheres well and gives a very good finish.

Packed in 100-lb. bags. Covering capacity, applied and dried, 18 sq. ft., 1″ thick, per bag.

No. 400 Insulating Cement
(For temperatures to 700 deg. F.)

No. 400 Cement is a smooth-finishing product of good insulating value. Not quite as hard as No. 302.

Packed in 100-lb. bags. Covering capacity, applied and dried, 25 sq. ft., 1″ thick, per bag.

J-M 85% Magnesia Cement
(For temperatures to 600 deg. F.)

This material is similar to J-M 85% Magnesia sectional and block insulation except that it is in powdered or cement form.

Compared with other cements, its insulating efficiency is high but it is not ordinarily recommended as a finishing cement.

Packed in 60-lb. bags. Covering capacity, applied and dried, 35 sq. ft., 1″ thick, per bag; or 58 sq. ft., 1″ thick, per 100 lb.

No. 319 Semi-Refractory Cement
(For temperatures to 1600 deg. F.)

No. 319 is a combined insulating and refractory cement, ideal for use as a protective coating over insulation linings of breechings, flues, etc., exposed to the erosive action of moving gases.

Packed in 50-lb. bags. Covering capacity, applied and dried, 7½ sq. ft., 1″ thick, per bag; or 15 sq. ft., 1″ thick, per 100 lb.

Superex Insulating Cement
(For temperatures to 1900 deg. F.)

Superex Insulating Cement is Superex Insulation in powdered or cement form for use on irregular or small surfaces where the application of blocks or sectional pipe covering is impractical.

Packed in 75-lb. bags. Covering capacity, applied and dried, 34 sq. ft., 1″ thick, per bag; or 45 sq. ft., 1″ thick, per 100 lb.

J-M Fibrous Adhesive

In the application of sheet, block or brick insulation to flat surfaces, as well as to curved surfaces of large diameters, it is necessary, in a majority of cases, that the insulation be temporarily held in place until the application of the outer binding support and final finish.

J-M Fibrous Adhesive successfully takes the place of other temporary binding methods, being applied easily and rapidly and yet furnishing a moderately strong and effective support for the insulation until the permanent panel or finish is applied which secures the insulation in place.

Fibrous Adhesive is recommended for use where insulation is applied to brick, concrete, metal or other surfaces, and is also a satisfactory adhesive for binding insulating blocks together in multiple layer construction.

Where temperatures do not exceed 500 deg. F., Fibrous Adhesive may be used as the principal means of attachment of insulation directly to the surface of ducts, flues, etc. In such cases, however, a secondary support should always be provided, such as cables or mesh wire, tightly laced over the surface of the blocks.

Fibrous Adhesive is applied to the face of the insulating material, which is then pressed in place against the surface to be insulated. It is not necessary to coat the entire face of the insulation if only temporary support is required, as spotting of the adhesive is usually sufficient.

Only a sufficient thickness of the adhesive to obtain a thin film for bonding need be used; however, the thickness required depends largely upon the smoothness of the surface. Bare metal surfaces require less adhesive than is necessary for application of insulation to brick or concrete or to other insulation.

All paint *must* be removed before insulation can be applied by Fibrous Adhesive, or the insulation will loosen after the adhesive dries out.

In estimating requirements, the following covering capacities may be used: For sticking insulation to metal surfaces, 50 lb. of Fibrous Adhesive will cover approximately 100 sq. ft. of surface. For sticking insulation to brick, concrete or other insulation, 75 lb. of Fibrous Adhesive will cover about 100 sq. ft.

Fibrous Adhesive is supplied ready for use, in 75-lb., 175-lb., 350-lb., and 600-lb. drums.

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J-M Insulating Fillers

Sil-O-Cel C-3

For temperatures to 2000 deg. F.

Sil-O-Cel C-3, a semi-refractory insulating product, is made from the mineral Celite, calcined in order that it may withstand temperatures as high as 2000 deg. F.

Sil-O-Cel C-3 is a coarsely ground, granular material with a sufficient proportion of fines to insure a uniform mass without large voids. It may be used alone as a granular filling material, or in combination with portland or lumnite cement to form Sil-O-Cel C-3 Concrete as described on another data sheet. Sil-O-Cel C-3 will not shrink and, for a material which can be used at so high a temperature, is a remarkably efficient insulator.

Sil-O-Cel C-3 is used for insulating tops and for filling walls of heated equipment operating at extremely high temperatures or in equipment where lack of space prohibits the use of any but relatively thin fire brick linings and where the insulation is therefore subjected to very high temperatures. A typical application of this material in dry form is in the bases of oil-fired marine boilers.

Sil-O-Cel C-3, loose, weighs about 28 lb. per cu. ft. When rammed into place moist, without the addition of any bonding material, it weighs approximately 31 lb. per cu. ft. Packed in bags of about 100 lb.

Sil-O-Cel Insulating Powder

For temperatures to 1600 deg. F.

Sil-O-Cel Insulating Powder is manufactured from the pure mineral Celite, milled to a high degree of fineness. Milling is very carefully done in specially designed equipment to preserve the natural cellular structure of the material. Sil-O-Cel Powder is furnished in bags of approximately 100 lb.

This material has an exceptionally high insulating value. It can be used where it will be subjected to temperatures as high as 1600 deg. F. When loosely poured, Sil-O-Cel Insulating Powder weighs about 12 lb. per cu. ft., and when packed in place to the proper density (15 to 17 lb. per cu. ft.) will retain its effectiveness indefinitely.

The high insulating efficiency of Sil-O-Cel Insulating Powder makes it ideally adapted for use where structural strength and rigidity are not required of the insulation. When used to cover the tops of furnaces, tunnel kilns and similar equipment, the material should be lightly tamped to a density of about 15 lb. per cu. ft. Tamping is facilitated by moistening. A convenient method of moistening is to sprinkle the material in the bags the day before it is to be used.

To prevent dusting when Sil-O-Cel Insulating Powder is used over the top of heated equipment, a lime or cement slurry is often used to form a top crust.

For packing in walls of ovens, furnaces, kilns, etc., it should be tamped to about 17 lb. per cu. ft.

Installing Sil-O-Cel Coarse Grade in wall of Harrop Tunnel Kiln at A. P. Green Fire Brick Co., Mexico, Mo. Sil-O-Cel Coarse Grade is also used on the top

Sil-O-Cel Coarse Grade

For temperatures to 1600 deg. F.

Sil-O-Cel Coarse Grade is a material very similar to Sil-O-Cel Powder, excepting that, as its name implies, it is not milled to such fineness as the powder. Shipped in bags of approximately 100 lb. It should be packed to a density of about 22 lb. per cu. ft.

Sil-O-Cel Coarse Grade is particularly adapted for insulating the walls of such equipment as lime kilns. vertical boilers, etc. Because of its coarser nature, it is easier to pack than Sil-O-Cel Powder.

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Fil-Insul

For temperatures to 1000 deg. F.

Fil-Insul is used as an insulating filler in irregular spaces where insulation in block or brick form is not practical and where a resilient high-grade filler is needed. It will permit considerable expansion and contraction because of its fibrous nature which also serves to prevent any settling or sifting through cracks. Weighs about 17 lb. per cu. ft. packed to proper density. Furnished in 80-lb. bags.

Fibro-Cel

For temperatures to 1800 deg. F.

Fibro-Cel is a mixture of diatomaceous silica and long fibre asbestos. Due to the asbestos fibre, this material has certain characteristics different from the ordinary powdered fillers. The fibres offset any tendency to settle or filter through cracks, which makes the material well adapted for use as a filler on gas generator sets, etc. Approximate weight, 18 lb. per cu. ft. when packed in place. Furnished in 80-lb. bags.

Therm-O-Bestos

Therm-O-Bestos, a waterproofed asbestos material of high insulating value, is used for filling underground conduit systems designed to house and insulate pipes conveying steam, hot water or other hot liquids. It is light in weight, permanently water-repellent and non-corrosive. Therm-O-Bestos is so compounded as to have a springy nature which prevents it from settling. It is packed in the conduit to a density of 7½ lb. per cu. ft. Furnished in 25-lb. bags.

Granulated Rock Cork

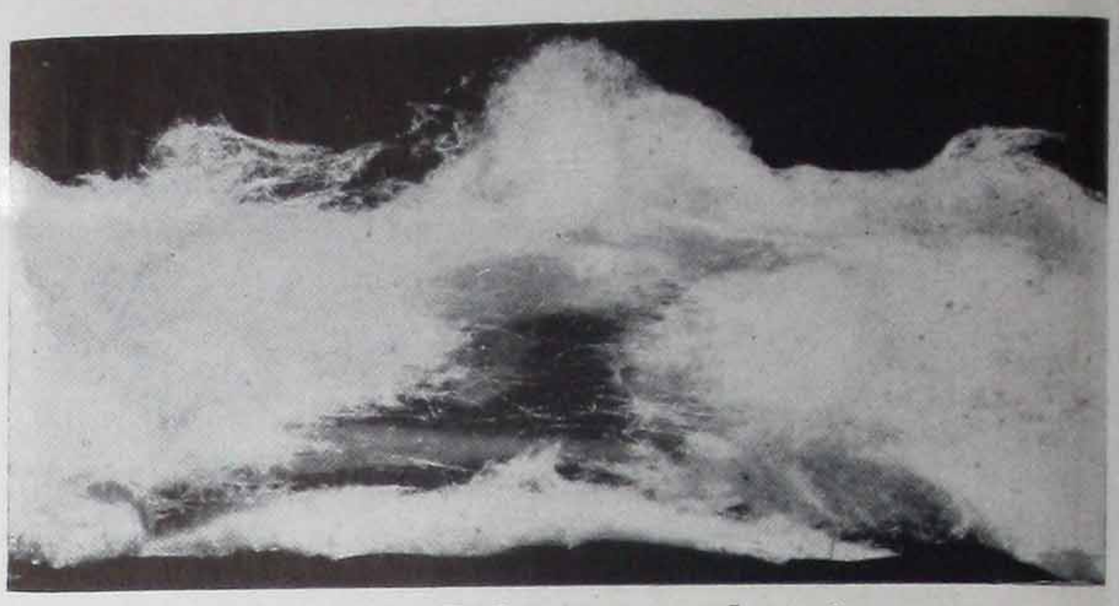
For temperatures below 100 deg. F.

Granulated Rock Cork, a rock wool product treated with a bituminous binder, is used where a loose, moisture-resisting filler, which can be poured into place, is required for low temperature service. It weighs 12 to 14 lb. per cu. ft., packed to the proper density. Furnished in 35-lb. paper bags and in burlap bags of random weights.

Zerofil

For temperatures below 100 deg. F.

Zerofil is an asphalt-impregnated loose rock wool (not granulated), designed for use as a low-temperature insulation where a hand-packed type of insulation must be used to fill irregular spaces. It is highly resistant to moisture. Zerofil weighs loose about 7 lb. per cu. ft. and should be packed to a density of about 10 lb. per cu. ft. It is shipped in random-weight burlap or 35-lb. paper bags.



Banroc Loose, pulled apart to show its texture

Banroc (rock wool)

For temperatures to 1000 deg. F.

Banroc is a lightweight, effective insulating material produced from high silica minerals. Safe temperature limit 1000 deg. F. Being non-combustible it is an effective fire retardant.

This material is used as an insulating filler in hollow oven walls, fireless cookers, domestic hot water heaters and for other purposes where a loose bulk insulation is required.

Banroc Loose:

The Banroc Loose regularly furnished, unless otherwise specified, is lightly oil-treated (sometimes called Annealed). A wide variety of other types, however, can be furnished on special order. *Banroc Loose—Medium Treated* and *Banroc Loose—Heavily Treated*, two grades so furnished, are given a heavier oil treatment than the regular grade. These are specified where a more moisture-resistant material is required, but they should not be considered waterproof. Among other special grades available are "*special white*" and "*special light density.*"

Banroc Loose may be packed to various densities but usually 12 lb. per cu. ft. is recommended. Unless otherwise specified, carload quantities are shipped in paper bags of approximately 35 lb. and smaller quantities in burlap bags of approximately 50 lb.

Banroc Granulated:

Banroc Granulated is made from regular Banroc Loose and is used primarily for hand-packing and pouring. It may be placed at various densities, but when the material is loosely poured into position, 9 to 10 lb. per cu. ft. is recommended and when hand packed, 10 to 12 lb. per cu. ft.

Unless otherwise specified, carloads of the material are shipped in paper bags weighing approximately 30 lb. and less than carload lots in burlap bags of approximately 50 lb.

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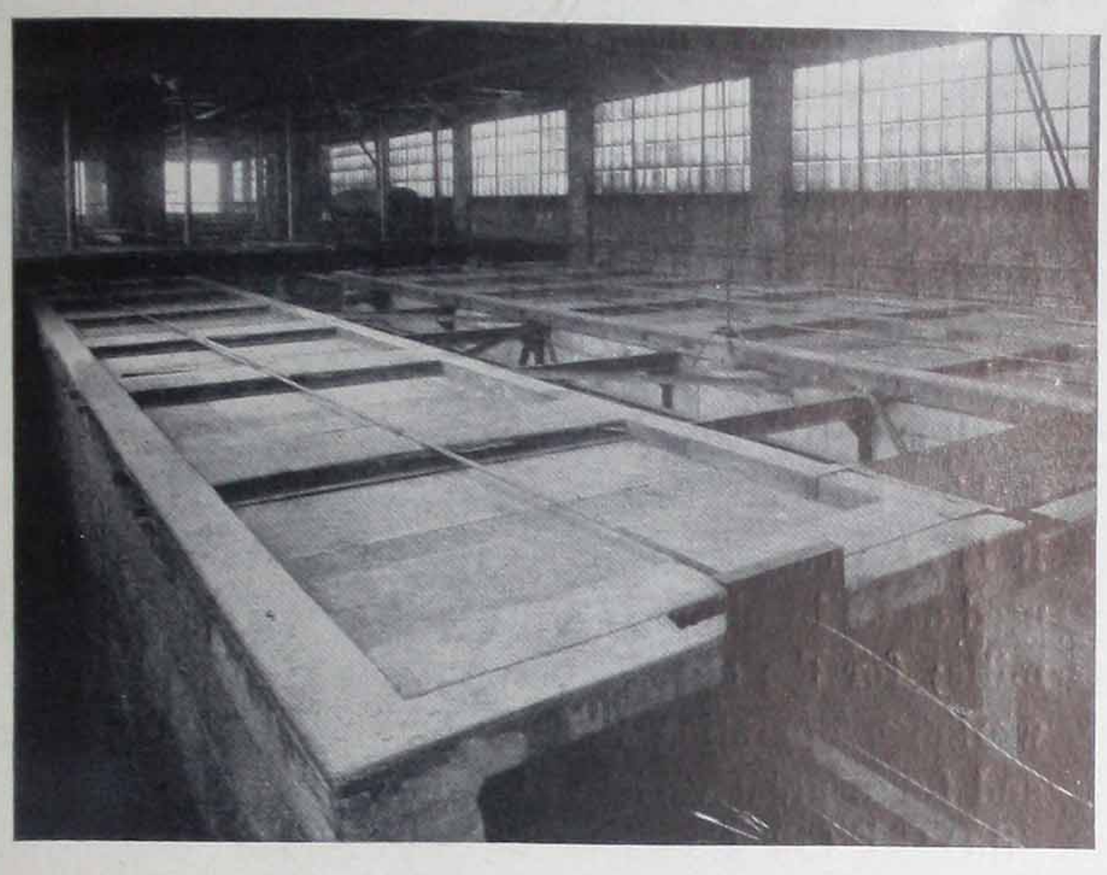
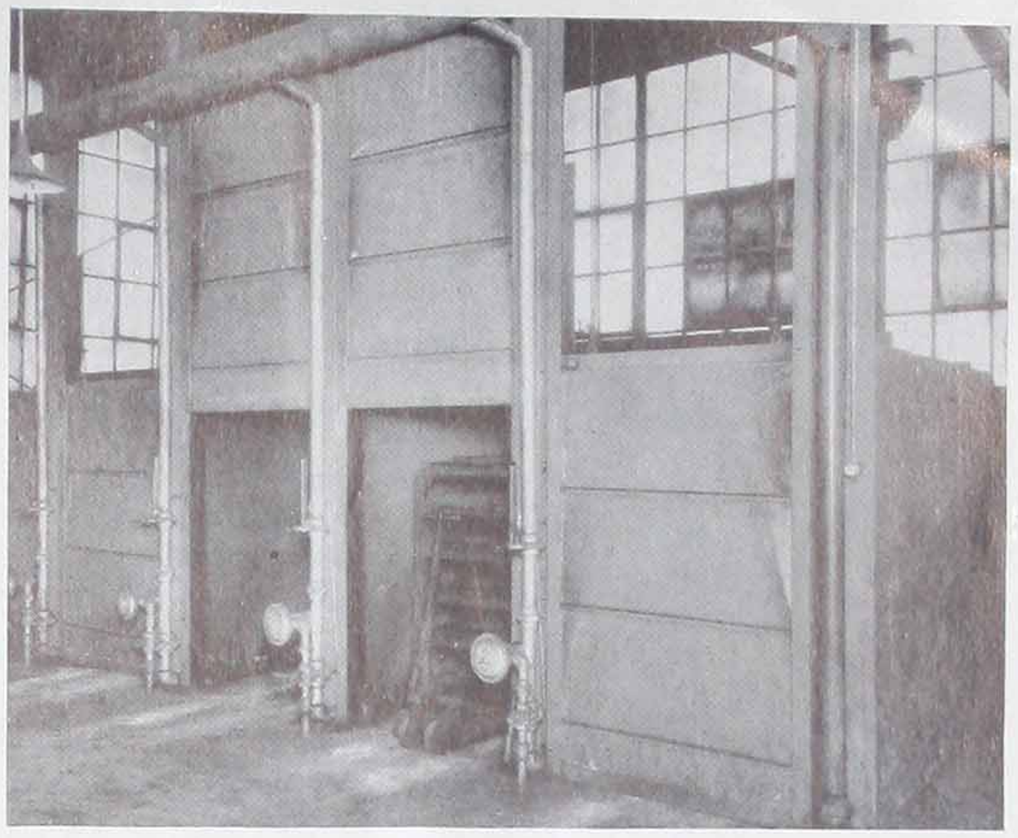
Sil-O-Cel C-3 Insulating Concrete

For temperatures to 1800 deg. F.



Large japanning ovens at the Durand Steel Locker Co., Chicago Heights, Ill., built entirely of Sil-O-Cel C-3 Concrete with 9" thick walls and tops. Size of ovens 9 ft. wide, 22 ft. high, 50 ft. long



Battery of four monolithic gas-fired core ovens, constructed throughout of Sil-O-Cel C-3 Concrete with 12" thick walls and tops. The doors were built of Sil-O-Cel C-3 Concrete 9" thick

Sil-O-Cel C-3 in the form of insulating concrete, can be cast into any shape desired. This has made it possible to utilize insulation where previously it had been impossible to do so for structural reasons. Sil-O-Cel C-3 can be easily cast in monolithic form for the construction of doors, baffles, dampers, etc., and, when suitably reinforced, may be moulded into large units for such purposes.

Sil-O-Cel C-3 Insulating Concrete is made by mixing four parts of Sil-O-Cel C-3 and one part of portland or lumnite cement, by *volume*, with sufficient water to form a plastic, coherent mass. Care should be taken to avoid excess water. For this purpose approximately 28 lb. of Sil-O-Cel C-3 are required per cu. ft., when rammed into place and dried.

Sil-O-Cel C-3 Concrete can be applied very satisfactorily to steel surfaces, such as stacks, by means of a cement gun. It can also be applied with a cement gun to the brick walls of existing equipment, such as open-hearth regenerators.

Sil-O-Cel C-3 Concrete is over three times as effective as fire brick in preventing heat penetration. Made in accordance with specifications, the material sets up into a strong, durable concrete weighing approximately 60 lb. per cu. ft. and with a crushing strength of about 1,000 lb. per sq. in. (72 tons per sq. ft.). It has a high degree of refractoriness for an insulating material and can be used without other refractory protection where it may be subjected to direct heat as high as 1800 deg. F.

Suitable reinforcing, such as would be used in ordinary concrete, and provision for expansion joints are important in the case of Sil-O-Cel C-3 Concrete as with any other monolithic material.

For monolithic construction of ovens, etc.:

Such equipment as japanning and enameling ovens, core ovens, etc., where the heating operation is carried on at a comparatively low temperature, are in many cases now being constructed entirely of Sil-O-Cel C-3 Concrete.

Ovens of this type can be constructed and operated at very great savings over the ordinary type of masonry construction. Due to the insulating properties of Sil-O-Cel C-3 Concrete and the fact that all masonry joints are eliminated, fuel consumption is surprisingly low. This construction can be satisfactorily employed for many types of equipment.

For foundations and bases:

Sil-O-Cel C-3 Concrete is an ideal material for insulating the bases of heated equipment. In fact, the practice of insulating bases can be said to have originated with the introduction of this material. It is used for base insulation in various types of heat-

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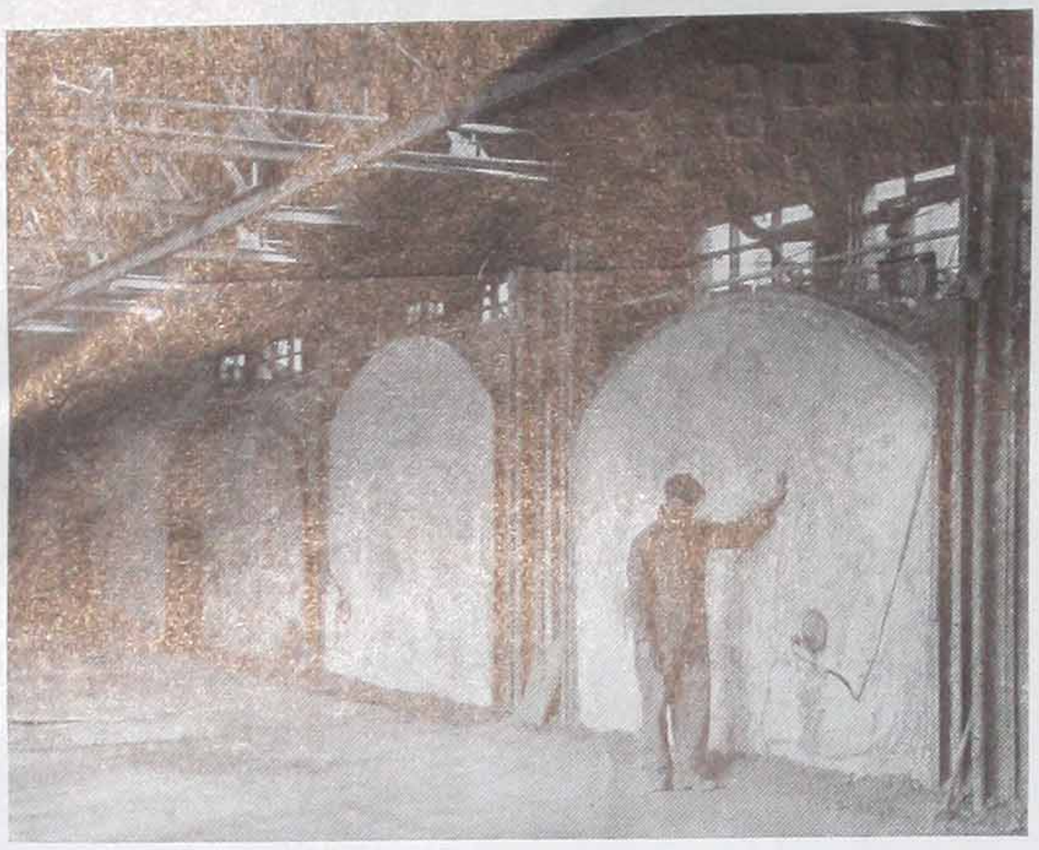


Sil-O-Cel C-3 Concrete is ideally adapted to the construction of monolithic furnace doors. The C-3 Concrete doors on this battery of malleable annealing ovens are 9" thick

treating furnaces, kilns, oil still furnaces, hot blast stoves, open-hearth furnace regenerators and flues, and in many other types of high temperature equipment where heat transmission through the base would otherwise amount to a considerable loss.

Insulation of the bases of such equipment is now recognized as being essential, not only because of the fuel saving, but also because it insures more uniform heat distribution within the equipment and protects the foundations from excessive heat.

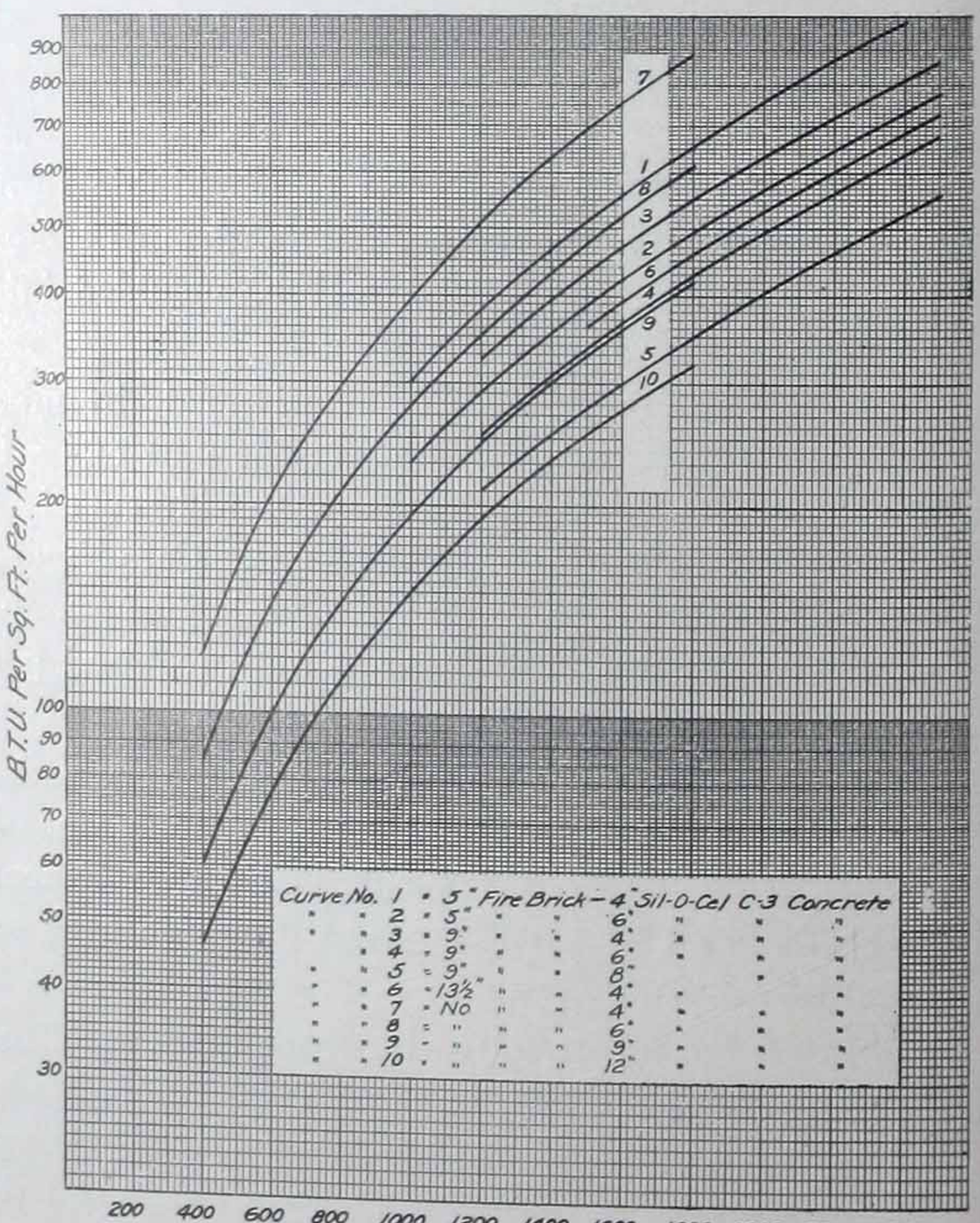
Sil-O-Cel C-3 Concrete doors:

Sil-O-Cel C-3 Concrete is the principal material in use today for furnace door construction. Fire brick doors, as formerly used, are highly conductive of heat. Such heat waste is costly, reduces the output of the furnace, disturbs temperature uniformity, makes close control impossible, and causes unsatisfactory conditions for the operators. Since fire brick weigh about 130 lb. per cu. ft., fire brick doors also have the disadvantage of great weight, which makes them hard to handle, and elaborate counterbalancing devices are often required. Sil-O-Cel C-3 Concrete weighs less than half as much as fire brick, conducts less than one-third as much heat and costs less per door installed.

On doors where the temperature is too high for Sil-O-Cel C-3 Concrete or where there is trouble due to erosion or abrasion, a protective facing* of Firecrete Refractory Cement, 1½" thick, is very effective. The C-3 Concrete is tamped into the door frame to a level approximately 1½" below that desired for the finished lining. While the concrete is still fresh, ½" of Firecrete is applied and rodded sufficiently to obtain a mixing of the Firecrete and C-3 for a depth of an inch or more below the surface of the mixture. Immediately thereafter, before the concrete has set, an additional 1" of Firecrete is applied without rodding, and troweled to a smooth finish level with the inside of the door.

Other uses:

Sil-O-Cel C-3 Concrete is an excellent material for making up special shapes such as baffles, dampers, etc. It is also cast into covers for wheel annealing pits; used as an insulating lining for hot metal cars in steel mills; for the construction of fire screens to protect workmen operating in front of open furnace doors; and for a great variety of other uses. In many cases Sil-O-Cel C-3 Concrete is particularly adapted for insulating on the outside of walls of equipment previously constructed without insulation. Application is effected through the use of wood or sheet metal forms or by means of a cement gun.



Heat losses through Sil-O-Cel C-3 Concrete, with and without fire brick linings

*U. S. Patent No. 2,042,870.

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Insulkote

Insulkote is a durable, easily applied, weather-proof coating for insulated surfaces. It is black when applied and turns to a gray in service. The finished surface may be painted with aluminum paint if desired. Temperature limit 400 deg. F.

Insulkote is particularly applicable for the protection of insulation on large tanks and vessels, and for insulated equipment, such as smoke breechings and ducts.

The advantages of Insulkote include the following:

1. Great durability under extreme weather conditions.
2. Elasticity which prevents its cracking under changes in atmospheric temperature.
3. Smooth surface finish.
4. Easy application.
5. Non-inflammable. Will not carry flame.
6. Furnished ready for application.

Insulkote is furnished in ready-mixed, plastic form and of suitable consistency to apply with a trowel. Orders placed between October 1 and May 1 are filled with "Winter Insulkote," for use when the temperature of the air is below 45 deg. F.

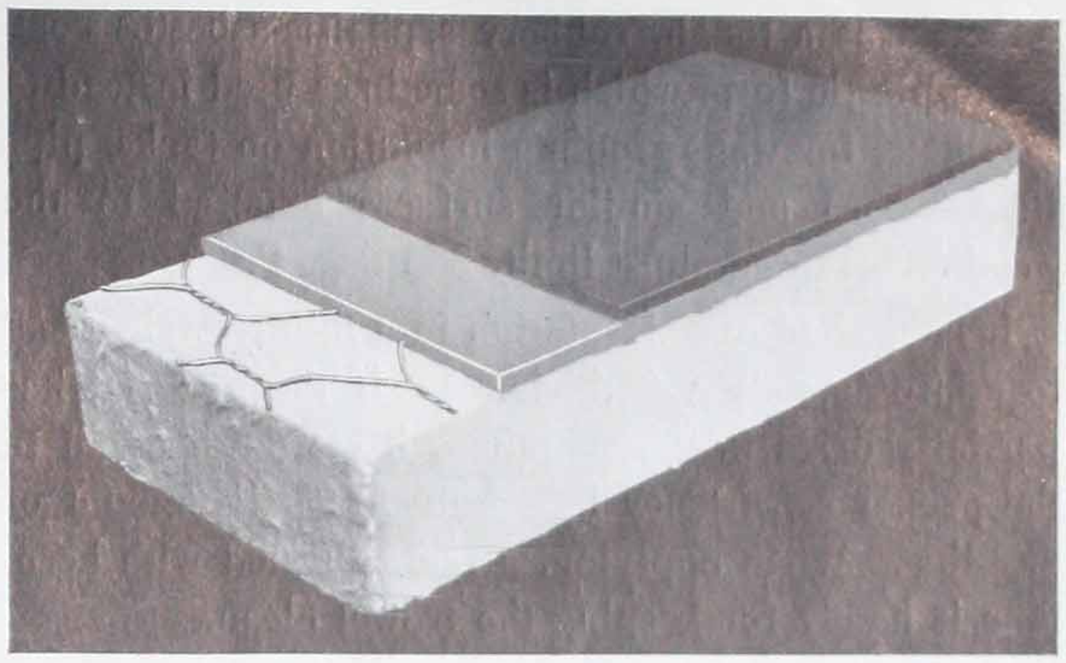
Insulkote, applied in one coat ¼″ thick, will cover approximately 45 sq. ft. per 100 lb. Furnished in 50-lb. pails, and in 150, 300 and 500-lb. drums.

Application

Insulkote should be applied as follows: Stretch the necessary reinforcing hexagonal mesh wire netting over the insulation. Then apply a ¼″ coat of insulating cement consisting of two parts by weight of J-M No. 302 Insulating Cement and one part portland cement. This coat should be scored and allowed to dry before applying the Insulkote.

Over the cement apply Insulkote approximately ¼″ thick in one layer, troweled to a smooth finish. The portland cement is added to produce a suitable surface to which to bond the Insulkote. If Insulkote is applied directly over wire mesh, an excessive quantity must be used to cover the pattern of the mesh.

After drying, the thickness of the Insulkote, applied ¼″ thick, will be approximately ⅛″ thick. Lesser thickness should not be used. This shrinkage is due to dehydration, which imparts the desirable features to the Insulkote.



When Insulkote is to be applied over the insulation of heated equipment, best results will be secured by applying the insulation and insulating cement while the apparatus is hot. If possible, the Insulkote should not be applied until the equipment has reached its approximate maximum temperature. Otherwise, expansion may cause cracking of the Insulkote. In the case of apparatus with a wide range of operating temperatures or frequent shut-downs, some form of expansion joint in the insulation is needed to prevent cracking of the finish.

While J-M No. 302 and portland cement provides the best base for Insulkote, other hard finish asbestos cements may be used if mixed, two to one by weight, with portland cement.

Insulkote Primer

Insulkote can be used on ordinary concrete or brick walls, Sil-O-Cel C-22 Brick or J-M Insulating Board, by the application of a coat of Insulkote Primer to these materials before the application of Insulkote.

Before using, the primer should be thinned to the proper paint-like consistency by adding clean water. This requires approximately 3 parts by volume of water to 2 parts of primer as received. The covering capacity of the thinned Insulkote Primer in square feet per gallon over certain materials is as follows:

Over Concrete	95
Red brick	120
Sil-O-Cel C-22 Brick	65
J-M Insulating Board	180

Insulkote Primer is furnished in 5, 30 and 55-gal. containers.

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Aertite Coating

Aertite is a tough, rubbery asphaltic-asbestos coating in plastic form which is sometimes used instead of Insulkote, for waterproofing insulation on tanks, pipe line flanges and similar surfaces exposed to the weather. Temperature limit, 250 deg. F.

It is applied over insulation in a thin troweled coat to approximately ⅛" thickness. If the material has partially dried in the container, it can be brought to the proper consistency by adding a small amount of gasoline. When applying, a rag saturated with kerosene is handy for keeping the trowel clean.

Aertite is black in color but can be painted with aluminum paint. If some other color is wanted, the Aertite should first be painted with aluminum paint and the other color then applied.

Aertite is furnished in 25, 50, 150, 300 and 500-lb. containers. The covering capacity depends somewhat upon the character of the surface. For a ⅛" coating, from 50 to 80 lb. per 100 sq. ft. of surface area, will be required.

Soft or dusty surfaces should be primed with J-M Concrete Primer before the Aertite is applied. Concrete Primer ordinarily covers about 100 sq. ft. per gal. It is furnished in 1, 5, 25 and 50-gal. containers.

In addition to its use as a weather protection for insulation, Aertite Coating is quite generally applied to the outside of boiler walls, to eliminate air infiltration. It provides a tough, rubbery, air-tight blanket over the entire boiler setting which remains tight because of its adhesive and ductile qualities and prevents imperfect combustion due to air leakage through the setting.

Application of Aluminum Paint

Preparation of Surface to be painted:

Insulkote shall be allowed to dry thoroughly before application.

Aertite shall be subjected to service conditions for about ten days before applying paint, to allow excess solvent to dry out.

Where paint is to be applied to roofing felts, it is only necessary that the surface be dry and clean.

Preparation of Paint:

The aluminum paint shall consist of 2 lb. of the Aluminum Company of America's Extra Brilliant Varnish Powder and one gallon of DuPont Company's No. RC 129 Aluminum Mixing Varnish, or its equal.

The paint shall be mixed immediately before using and in no case shall more paint be made up than can be used the same day.

Application:

The paint shall be applied in two coats, the first of which shall be allowed to stand not less than 24 hours or longer as required to dry thoroughly, before the second coat is applied.

The paint can be applied by brushing, but a spray will give a quicker, and possibly slightly smoother, job.

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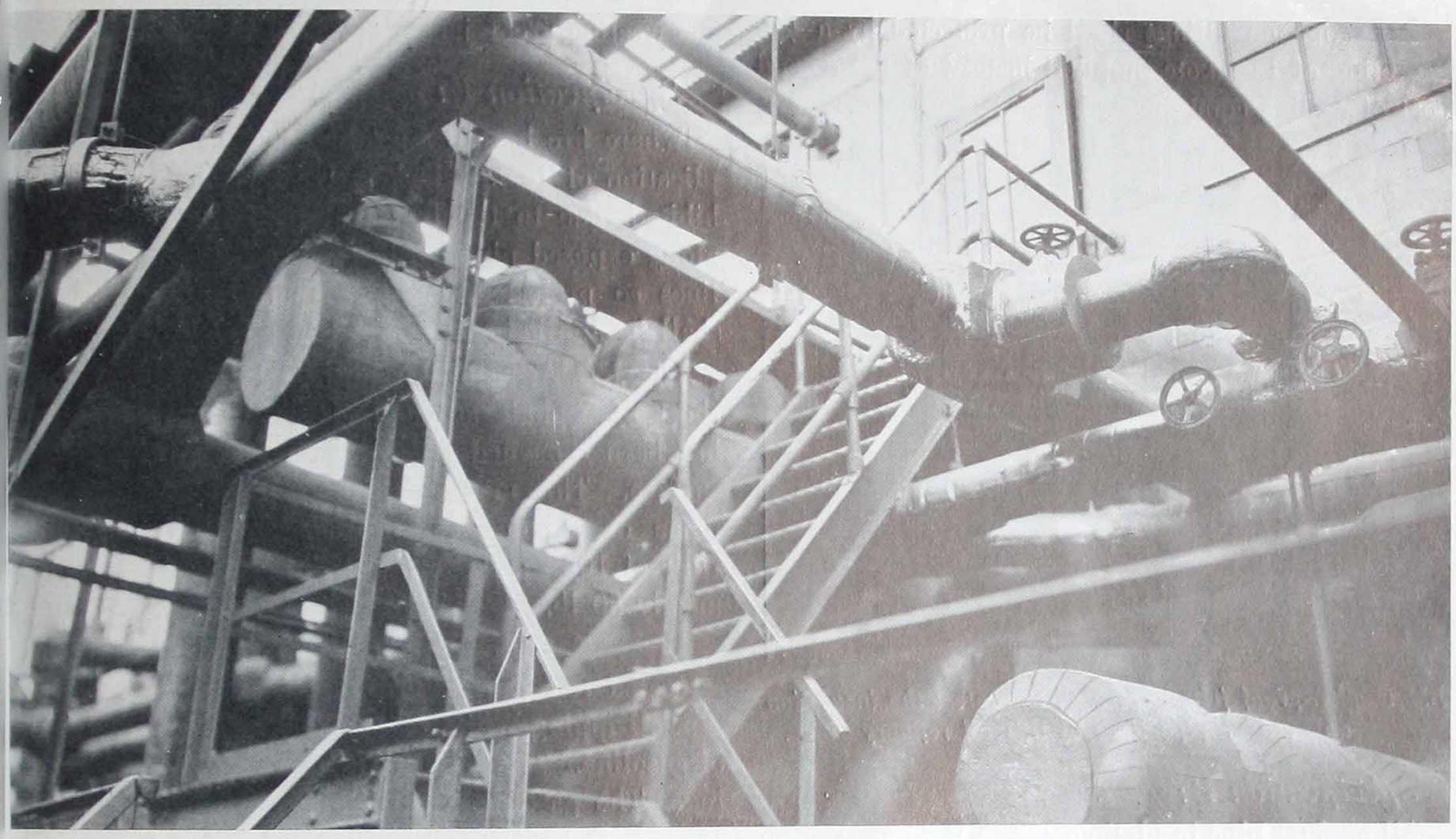
Jackets for Outdoor Pipe Insulation



This J-M Rock Cork Pipe Insulation job was photographed 4 years after its installation. The waterproof jacket maintained, unimpaired, the high efficiency of the insulation

Specification A:

All outdoor pipe insulation, except low-temperature piping, shall be protected from the weather by means of a weather-proof jacket of Double Coated Flexstone. (This material is furnished in rolls of 108 sq. ft., 32″ wide, and weighing approximately 50 lb.)

All joints shall be lapped at least 3″, and all horizontal laps shall be located on the side of the pipe with the laps turned downward in order to shed water.

The jacket shall be secured in place by means of rings of No. 16 B. & S. gauge Copperweld wire applied on not greater than 4″ centers.

All flange, fitting and valve insulation located outdoors shall be finished with J-M Insulkote, applied ¼″ thick, in place of the final outer coat of asbestos cement. The cement coat, over which the Insulkote is applied, shall be mixed with portland in the proportions of two parts asbestos to one part portland cement by weight and shall be scored and allowed to dry before troweling on the Insulkote to a smooth finish.

Specification A-1:

Rock Cork Pipe Insulation on outdoor lines shall be protected as follows: The insulation shall be applied in accordance with J-M standard recommendations, after which the sectional pipe insulation shall be protected with a jacket of Double Coated Flexstone, as in Specification A.

Zerotex Fitting Insulation, properly sealed and coated in accordance with the application directions, shall receive a ¼″ coat of Insulkote, troweled to a smooth, even finish.

When lagging is applied over sectional insulation to provide the required thickness, the regularly specified outer wrapping of J-M No. 50 Asbestos Waterproofing Felt, finished with a coat of Zerogloss, is adequate protection for service on outdoor lines.

Specification A-2:

Built-up Brine and Ammonia Pipe Insulation on outdoor lines shall be protected as follows: The insulation shall be applied in accordance with J-M

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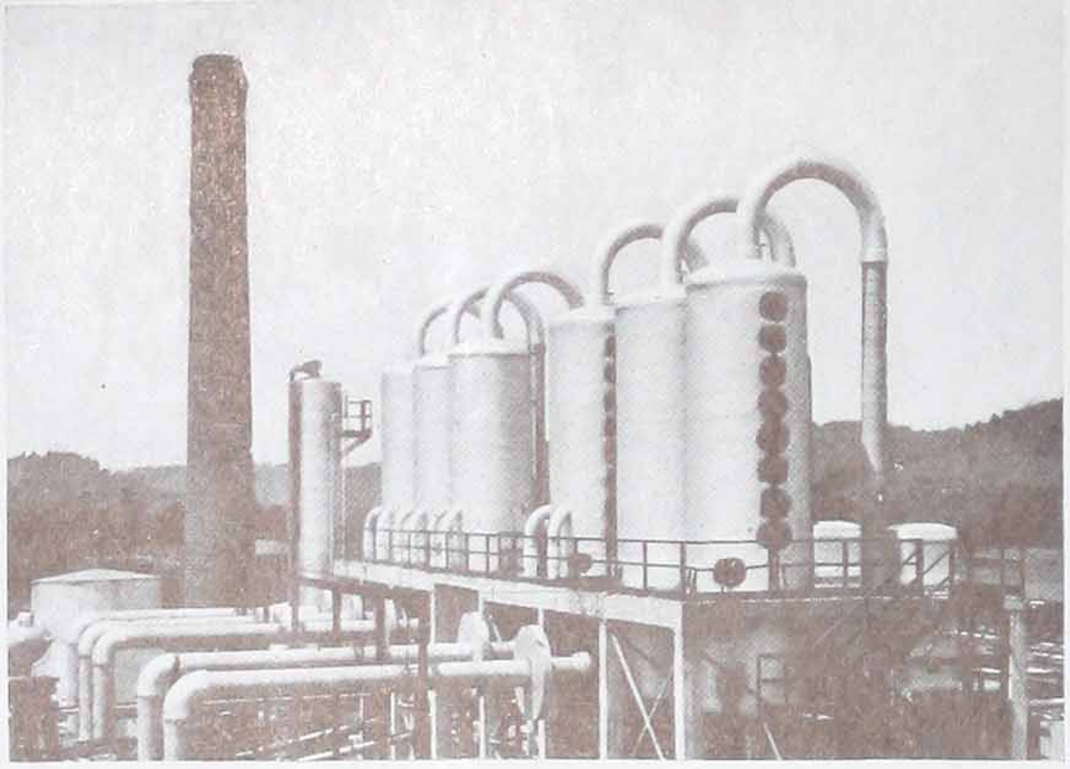
standard recommendations, including the sealing membrane, after which a weather-proof jacket of Double Coated Flexstone shall be applied over the sectional pipe insulation according to Specification A.

Insulation on fittings shall be protected by a ¼″ troweling of Insulkote, applied instead of the second coat of sealing compound.



J-M weather-proof felts were used to protect the insulation on outdoor pipe lines of this oil refinery

Specification B:

All outdoor pipe insulation, except low-temperature piping, shall be protected from the weather by means of a weather-proof jacket of Medium Pilot Roofing. (This material is furnished in rolls of 108 sq. ft., 36″ wide, and weighing approximately 45 lb.)

Application of the jacket on sectional pipe insulation and protection of the flange, fitting and valve insulation shall be exactly as outlined in Specification A.

Specification C:

Where the weather-proof jacket is furnished as an integral part of the insulation, the lap shall be turned downward in order to shed water from the surface, and shall be sealed with Laptite*.

A strip of waterproofing felt 7″ wide, as furnished with the insulation, shall be applied over each butt joint and shall be sealed to the jacket with Laptite.

The lap in this circumferential strip shall be placed on the opposite side of the pipe from the jacket lap and shall be turned downward in order to shed water.

The jacket shall be secured in place by means of rings of No. 16 B. & S. gauge Copperweld wire applied on not greater than 4″ centers.

* Laptite is an asphaltic cement, furnished in ½, 1, 5, 25 and 50-gal. containers. Where hot asphalt is available, it may be used in place of Laptite.

Specification D:

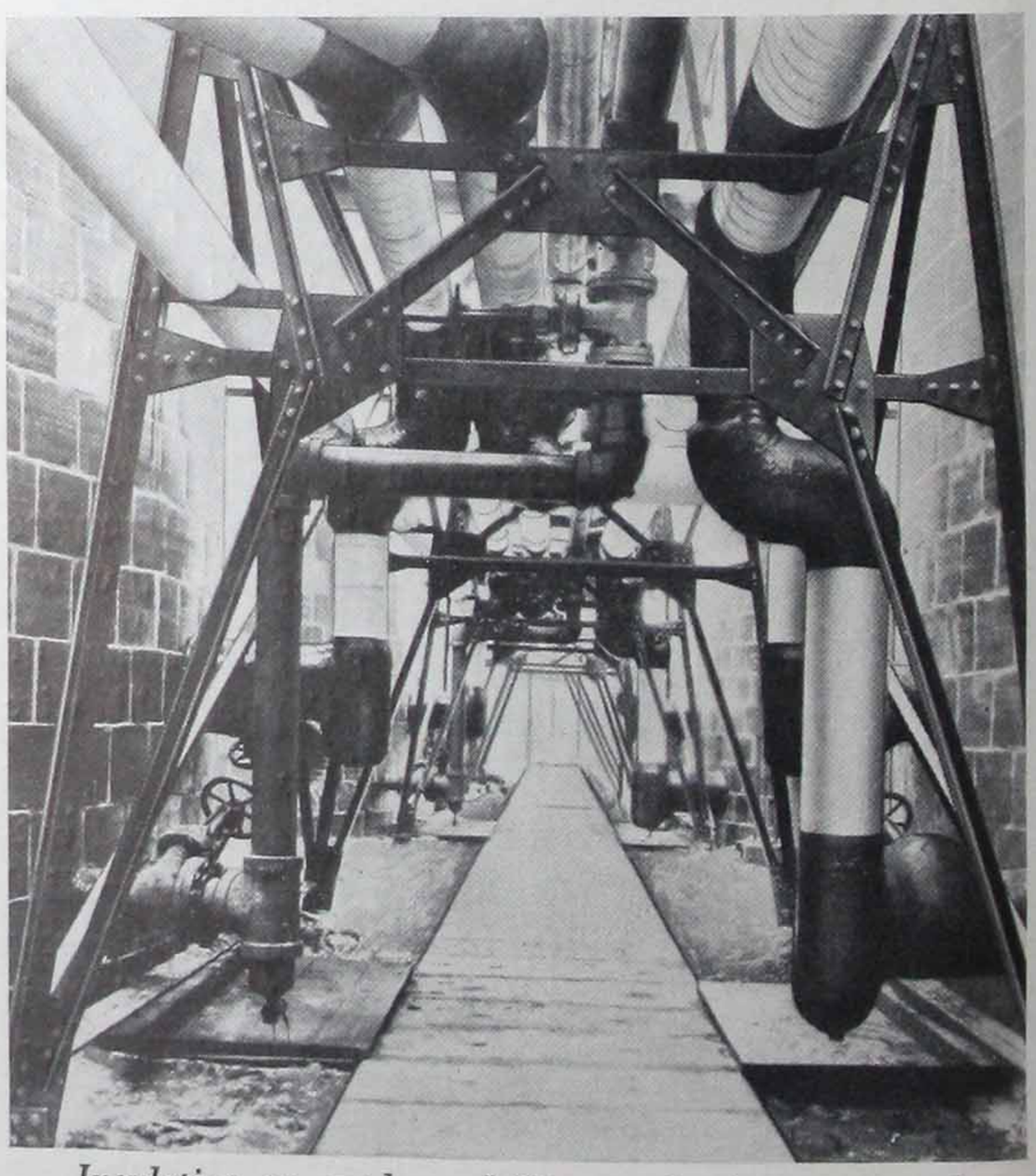
In exceptional cases where the jacket would be subjected to mechanical injury from excessively rough usage, a suitable metal jacket shall be substituted for the weather-proof jacket specified above.

Specification E:

Where fire hazard must be considered and the application of roofing jackets (as in A and B) is prohibited, due to the fact that flame may be carried along exposed piping when a fire occurs adjacent to lines so protected, a J-M Asbestos Firetard Jacket shall be applied as described in Specification A.

The J-M Asbestos Firetard Jacket consists of one sheet of asphalt-saturated asbestos felt, over which has been cemented an unsaturated felt for an outer surface. This material will not drip asphalt, carry flame or support combustion. It is furnished in rolls of 108 sq. ft., 32″ wide, and weighing approximately 50 lb.

Any slight exfoliation or disintegration in the unsaturated felt can be arrested by an application of Sipe's Dipping White Paint mixed with an equal part of gasoline. The mixture results in a thin, white coating. The gasoline volatilizes comparatively rapidly after it is applied. Sipe's Dipping White Paint is made by J. B. Sipe and Company, Pittsburgh, Pa.



Insulation on outdoor chilling tank pipes protected by a J-M weather-proof jacket, using Firetard felts on straight runs

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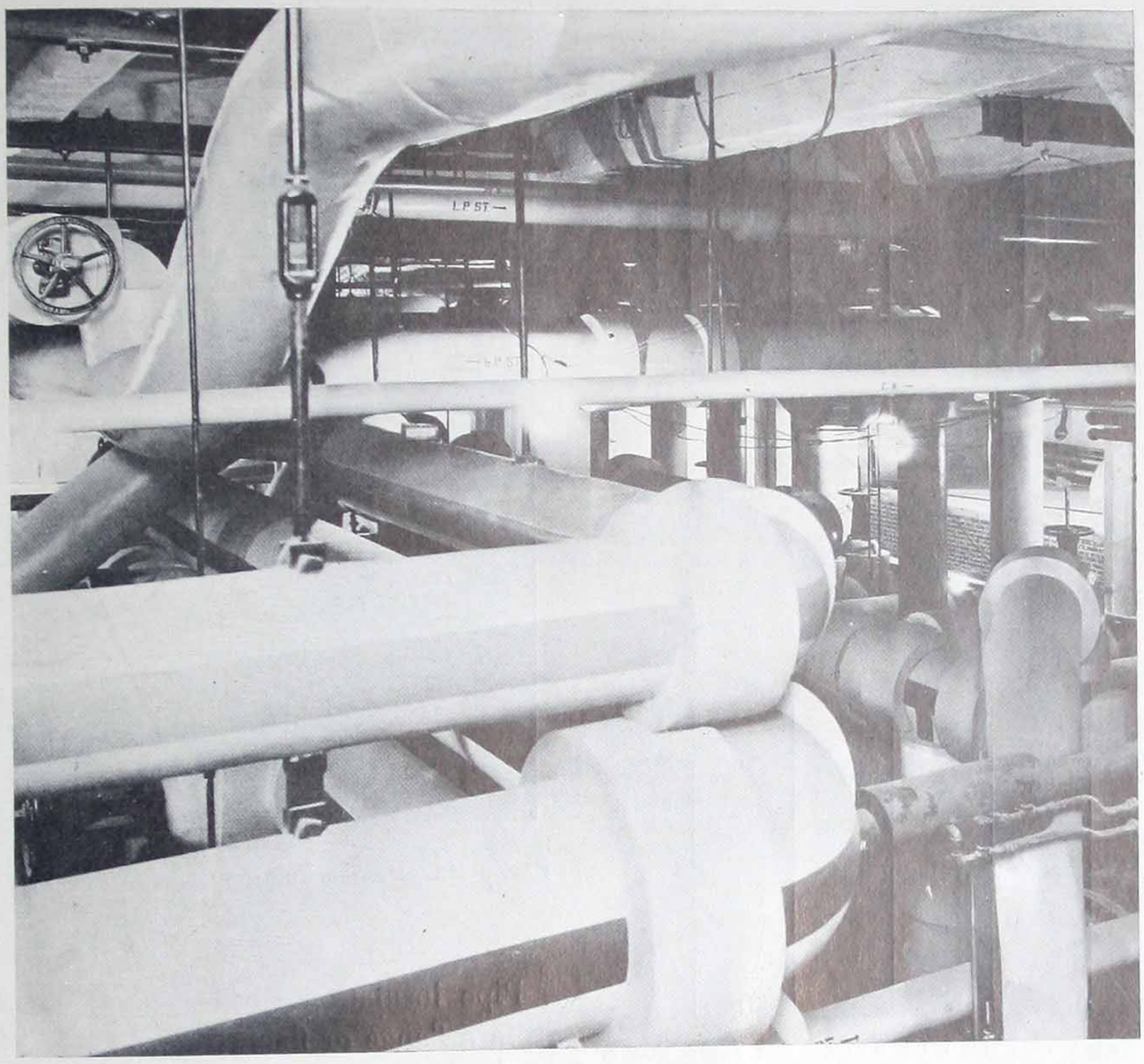
Insulation of Power Plant Equipment



Steam headers and heating mains insulated with J-M 85% Magnesia Pipe Insulation in the power sub-station of the New York Central Railroad under the Grand Central Terminal, New York City

Johns-Manville furnishes a wide variety of power plant materials for improving performance, increasing capacity and reducing operating costs. Fuel cost is one of the principal items of expense wherever heat is generated, and the problem of fuel conservation is a matter of major consequence. Insulation, therefore, is particularly important in insuring economical operation. A complete line of insulating materials in all forms is available to save heat otherwise dissipated from boiler settings and drums, economizers, breechings and stacks, turbines, pumps, feed-water heaters, piping and other locations where heat is being wasted.

Pipe Insulation

The insulation of bare metal surfaces where steam or hot water is in contact with the metal is even more important than insulation over brickwork. Asbesto-Sponge Felted in sheets or pipe sections is recommended up to 700 deg. F. where the insulating material will be subjected to rough usage. Moulded blocks or pipe sections of J-M 85% Magnesia are also highly efficient in the temperature range below 600 deg. F. At higher temperatures, Superex or Superex Combination Insulation should be used.

The term Superex Combination refers to the use of Asbesto-Sponge Felted or J-M 85% Magnesia outside of Superex, which is placed next to the heated surface. This construction is slightly more efficient than Superex used alone, and, in the case of Asbesto-Sponge Felted, more resistant to hard usage. Other materials for special conditions are available to meet every requirement.

The tables of thicknesses which follow represent standardized practice in general use on heated lines. Exceptional conditions may make necessary thicker insulation. Where piping is located outdoors, it is customary to use insulation ½″ thicker than that used on the lines indoors.

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Asbesto-Sponge Felted or 85% Magnesia for temperatures to 700 deg. F.

Thickness of insulation, J-M 85% Magnesia			Temp., deg. F.	Thickness of insulation, Asbesto-Sponge Felted		
Pipes larger than 4"	Pipes 2" to 4"	Pipes smaller than 2"		Pipes larger than 4"	Pipes 2" to 4"	Pipes smaller than 2"
Std.	Std.	Std.	Below 212	1"	1"	1"
Std.	Std.	Std.	212 to 266	1"	1"	1"
1½"	Std.	Std.	267 to 337	1½"	1"	1"
2"	1½"	Std.	338 to 387	2"	1½"	1"
Dbl. Std.	2"	1½"	388 to 499	2½"	2"	1½"
3"	Dbl. Std.	2"	500 to 599	3"	2½"	2"
*	*	*	600 to 700	3½"	3"	2"

* 85% Magnesia not recommended over 600 deg. F.

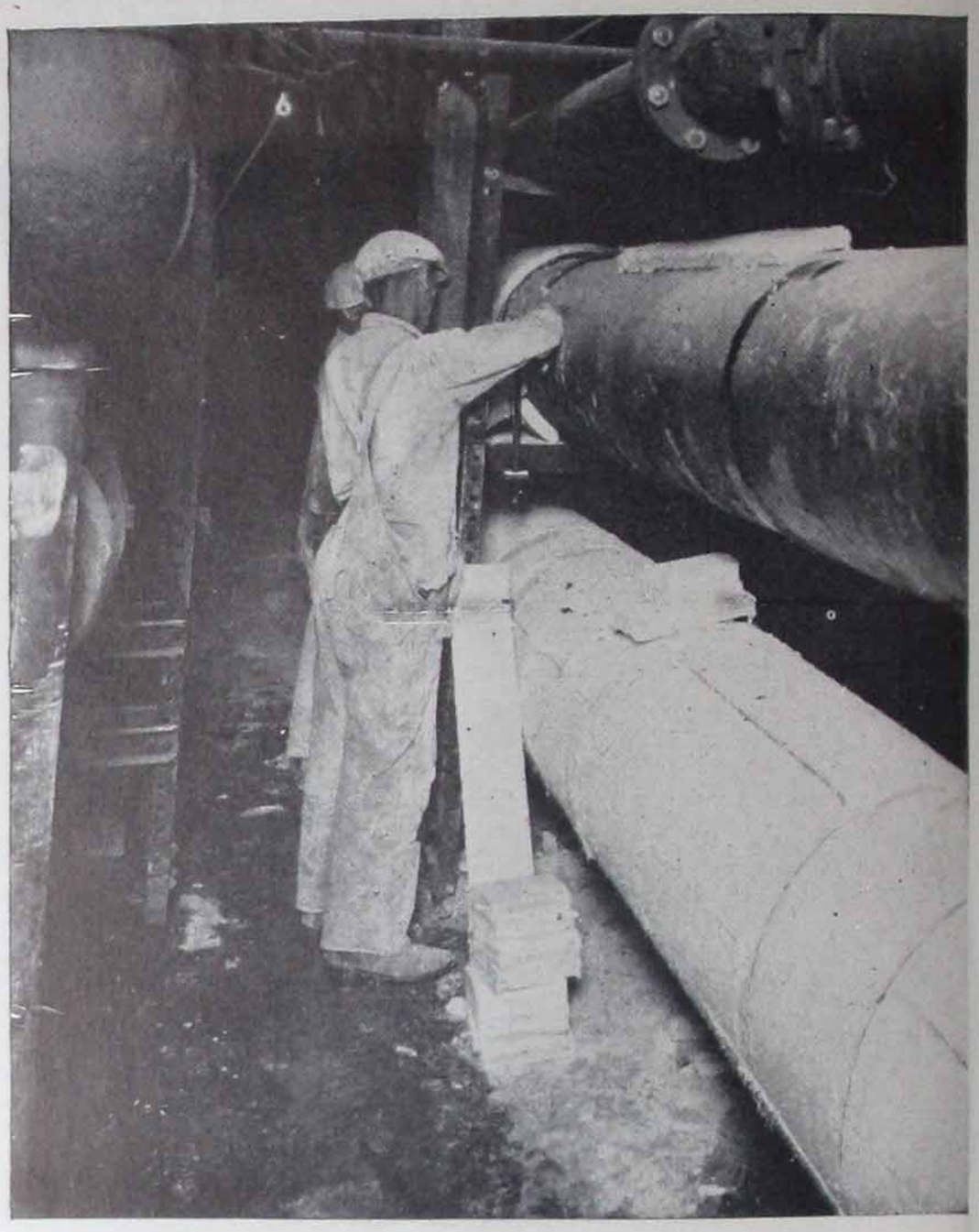
Superex Combination Insulation for temperatures above 600 deg. F.

Pipe size, inches	600-699 deg. F †		700-799 deg. F.		800-1000 deg. F.	
	Thickness of insulation		Thickness of insulation		Thickness of insulation	
	Superex, in.	85% Magnesia, in.	Superex, in.	Asbesto-Sponge Felted, or 85% Magnesia, in.	Superex, in.	Asbesto-Sponge Felted, or 85% Magnesia, in.
1¼ or less	2	....	2	....	2	....
2	1¼	1½	1¼	2	2⅛	1½
2½	1⅝	1½	1⅝	2	1 13/16	1½
3	1 13/16	1½	1 13/16	2	2 1/16	1½
3½	1⅝	1½	1⅝	2	1 13/16	1½
4	1 13/16	1½	1 13/16	2	2 1/16	1½
4½	1⅝	2	1⅝	2½	1 13/16	2
5 or more	1½	2	1½	2½	2††	2

† Asbesto-Sponge Felted may be used alone. See table above.
†† Approximate; varies from 2" to 2⅛" according to pipe size.

Pipe insulation is securely fastened in place with not less than three loops of 16-gauge annealed iron wire on pipes up to and including 6", and with not less than four loops on larger sizes. In double layer work both longitudinal and circumferential joints are staggered and each layer is wired separately. Inside piping is finished with 8-oz. canvas sewed over a layer of asbestos paper or rosin-sized paper. Where similar pipes run close together they may be insulated as a unit, using block insulation and half sections of pipe insulation, finished with canvas the same as a single pipe.

Fittings and valves are insulated with blocks and J-M No. 302 Insulating Cement to a thickness equivalent to the adjacent pipe insulation. No. 302 Cement is often used alone on screwed fittings or over the bodies of small flanged fittings or where the total thickness of insulation is less than 1½". In any case the customary finish is 8-oz. canvas, pasted smoothly to the surface of the cement.



Large steam lines being insulated with J-M 85% Magnesia, Double Standard Thick

Pipe insulation is stopped at a sufficient distance from a flange or flanged fitting to allow free removal of the bolts, and blocks are wired around the flange to extend not less than 2" over the adjacent pipe insulation. The cement finish is applied in two coats to a total thickness of ½", the first or rough coat being allowed to dry before application of the smooth finish coat.

Instead of blocks around a flange, it is frequently convenient to use short sections of pipe insulation of a size which just fits snugly against the periphery. These flange covers are wired in position and finished the same as in the other method, except that the cement may be applied in a thinner coat.

On outdoor lines protection of the insulation from the weather is afforded by a flexible waterproof jacket, carefully sealed to shed the rain and held in position by non-corroding wire on 4" centers.

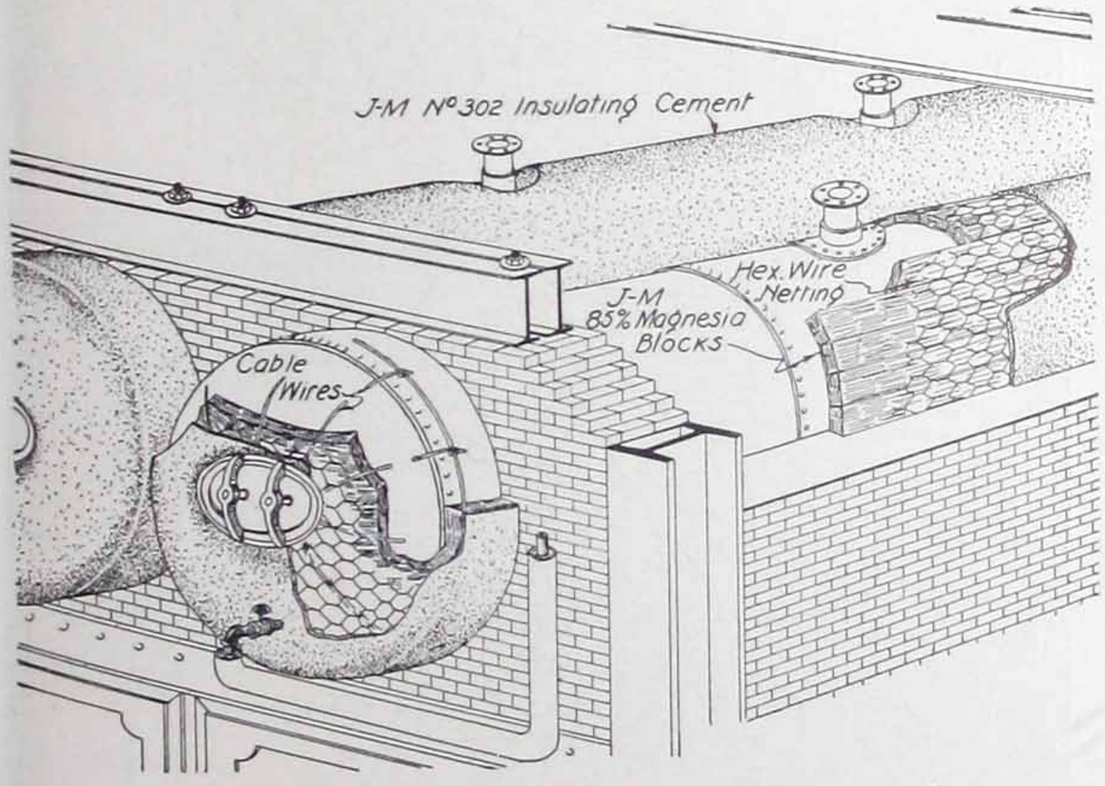
Outdoor valves and fittings are weather-proofed by replacing the final ¼" coat of cement with Insulkote, care being taken effectively to seal the joints between the pipe insulation jacket and the Insulkote over the valve or fitting. Lines subject to mechanical injury are usually protected by a sheet metal casing.

Boiler Room Ceilings and Walls

To confine heat and prevent excessive temperatures in adjacent spaces—boiler rooms, steam distribution rooms and pipe corridors should be insulated with 2″ thick J-M 85% Magnesia Blocks. These are adhered to the treated surface by means of J-M Fibrous Adhesive and are butted closely and pressed firmly into place. The blocks are further secured, on new construction, by means of ½″ x .020″ metal straps, set in the concrete forms on 12″ x 36″ centers, or, on existing construction, with 16 ga. annealed iron wire, stapled to 2″ x 2″ wood strips. The insulation is then finished with reinforced asbestos cement.

Boiler Shells and Drums, Turbines, etc.

In power plant work the exposed steam and water surfaces of boilers, feed-water heaters, steam pumps and turbines are insulated with blocks of the proper thickness depending on temperature. H.R.T., fire-box type and cast-iron sectional boilers and the drums of water-tube boilers are insulated with J-M 85% Magnesia Blocks, 1″ thick, for steam pressures up to 25 lb.; 1½″ thick for pressures up to 100 lb.; 2″ thick for pressures up to 200 lb.; and 2½″ thick for pressures over 200 lb. Steam turbines at temperatures below 300 deg. F. are insulated with J-M 85% Magnesia Blocks 1½″ thick; at temperatures from 300 to 400 deg. F., 2″ thick; and at temperatures from 400 to 600 deg. F., 3″ thick. Turbines at temperatures between 600 and 700 deg. F. are insulated with 1½″ Superex and 1½″ J-M 85% Magnesia Blocks. Recommendations for higher temperatures may be secured from Johns-Manville. Feed-water heaters are insulated with 1½″ J-M 85% Magnesia. On pump cylinders and chests, 2″ Magnesia Blocks are used.



Method of insulating drums and drum-heads

Two coats of J-M No. 302 Insulating Cement of a total thickness of ½″, reinforced with hexagonal mesh wire, are applied over the blocks, the first coat being left to dry with a rough surface and the second troweled smooth and hard. A suitable metal jacket is provided where the insulation is likely to be damaged, as on a steam pump or turbine.

Brickset Boiler Insulation and Casing

Insulation over boiler brickwork saves fuel, provides closer temperature control, reduces air infiltration and assures better working conditions. Added to this is the decrease of internal strains and reduction in spalling because of the smaller temperature differential between the inside and outside of the refractory. Insulation placed over exterior brickwork promotes heat flow along the walls, and the back passes are raised to a higher temperature. Wall cracks, caused by uneven expansion and contraction, are fewer and smaller.

A veneer layer of Superex or Magnesia Insulation or Superex-Magnesia Combination Insulation of a thickness depending on the design of the boiler is applied over the brick and, preferably, finished with flat Transite. The insulation may be applied behind or between the buckstays. If brick shapes are preferred, Sil-O-Cel or JM-20 Brick are laid up, either bonded or unbonded, behind the refractory lining.

Block Insulation Recommendations for typical water-tube boilers

Type of boiler	Front Wall	Side Walls		Rear Wall	Top
		From front wall to bridge wall	To rear of bridge wall		
B & W	3″ Superex-Magnesia Combination	3″ Superex-Magnesia Combination	1½″ Magnesia (1 layer)	None	2½″ Magnesia (1 layer)
Stirling	3″ Superex-Magnesia Combination	3″ Superex-Magnesia Combination	3″ Magnesia (2 layers)	1½″ Magnesia (1 layer)	3″ Superex-Magnesia Combination
Springfield	None	3″ Superex (2 layers)		3″ Superex (2 layers)	3″ Superex-Magnesia Combination

If block insulation is placed between buckstays, light angles may be clipped or spot-welded to the buckstays and punched so that insulation may be secured in place by lacing wires. These angles also serve as support for the Transite casing. Transite has a much lower conductivity than most casing materials,

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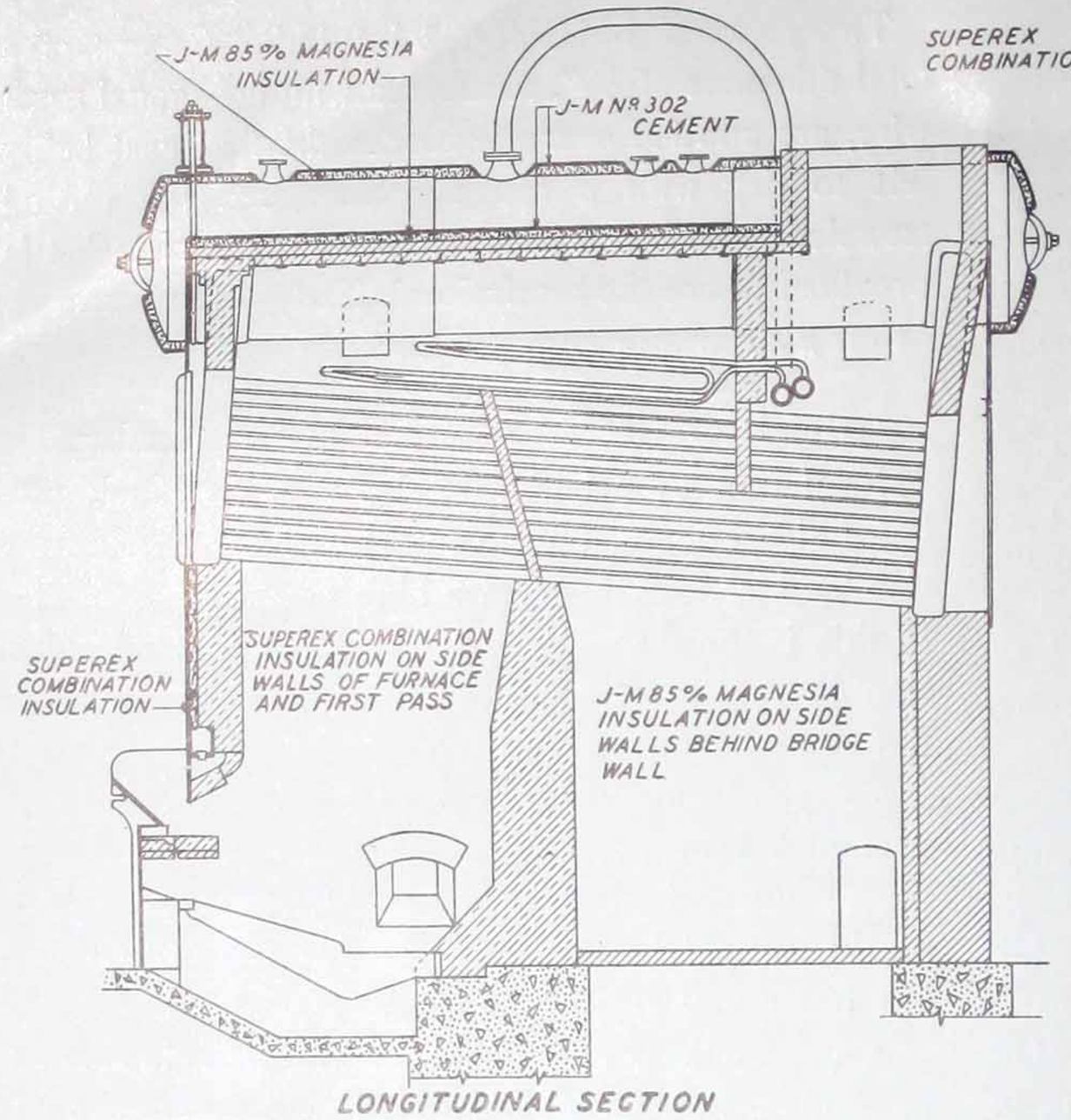
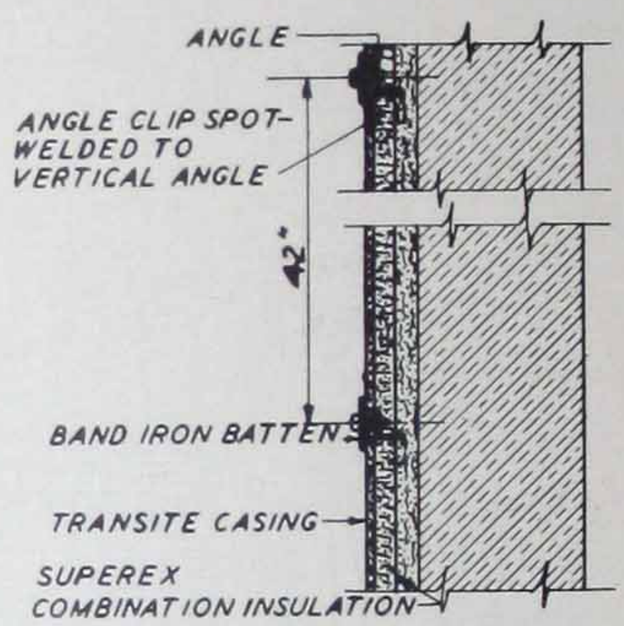




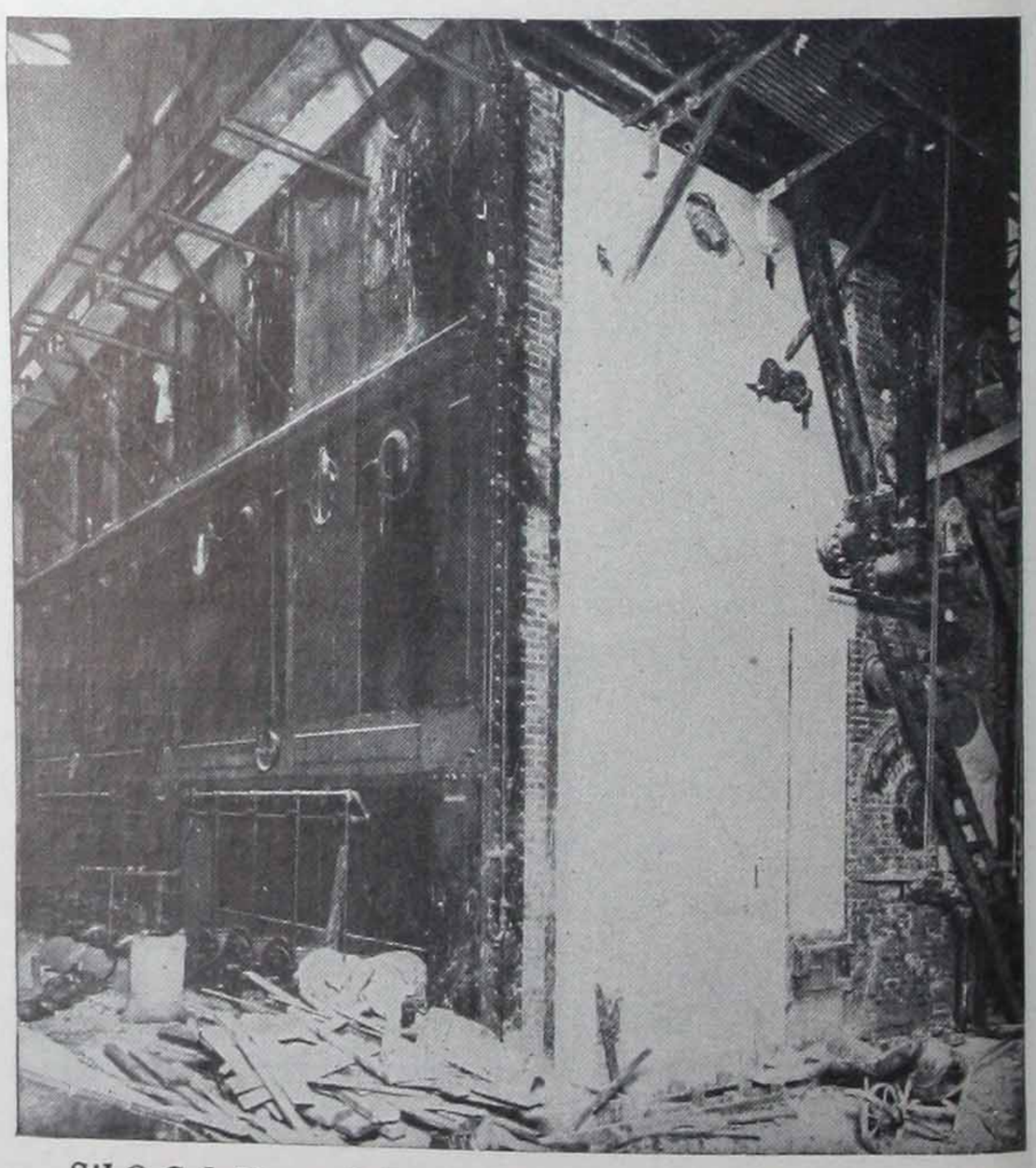
Typical block insulation and Transite casing on horizontal, longitudinal drum boiler (Erie City boiler with Elesco superheater)

is lighter in weight and makes a better appearance. It is light gray in color, very resistant to corrosion, and when put up in panel type construction with steel battens over the joints is easily removed and replaced.

A reinforced asbestos cement finish may be used over those portions of the insulation not subject to mechanical damage, but the Transite affords better protection and will present a good appearance after years of usage.

On new settings a veneer of 4½″ Sil-O-Cel C-22 Brick may be bonded into the outside of the fire brick every fifth course vertically. On old settings, spikes or expansion bolts with wires attached may be driven into mortar joints on 2-ft. centers and 4½″ Sil-O-Cel Natural Brick laced to the brickwork without bond of any kind. The C-22 Brick present an attractive and durable surface as laid but if desired they may be coated with Insulkote Primer and Insulkote to prevent air infiltration. The Natural Brick are finished with two ¼″ coats of cement, reinforced with wire netting.

On new settings of H.R.T. boilers and small water-tube boilers, a "core wall" of 4½″ Sil-O-Cel Natural Brick is often laid between fire brick and red brick and bonded every fifth course vertically. Opposite the furnace and first pass of water-tube boilers Sil-O-Cel C-22 Brick are used.



Sil-O-Cel Natural Brick veneer on existing wall of water-tube boiler

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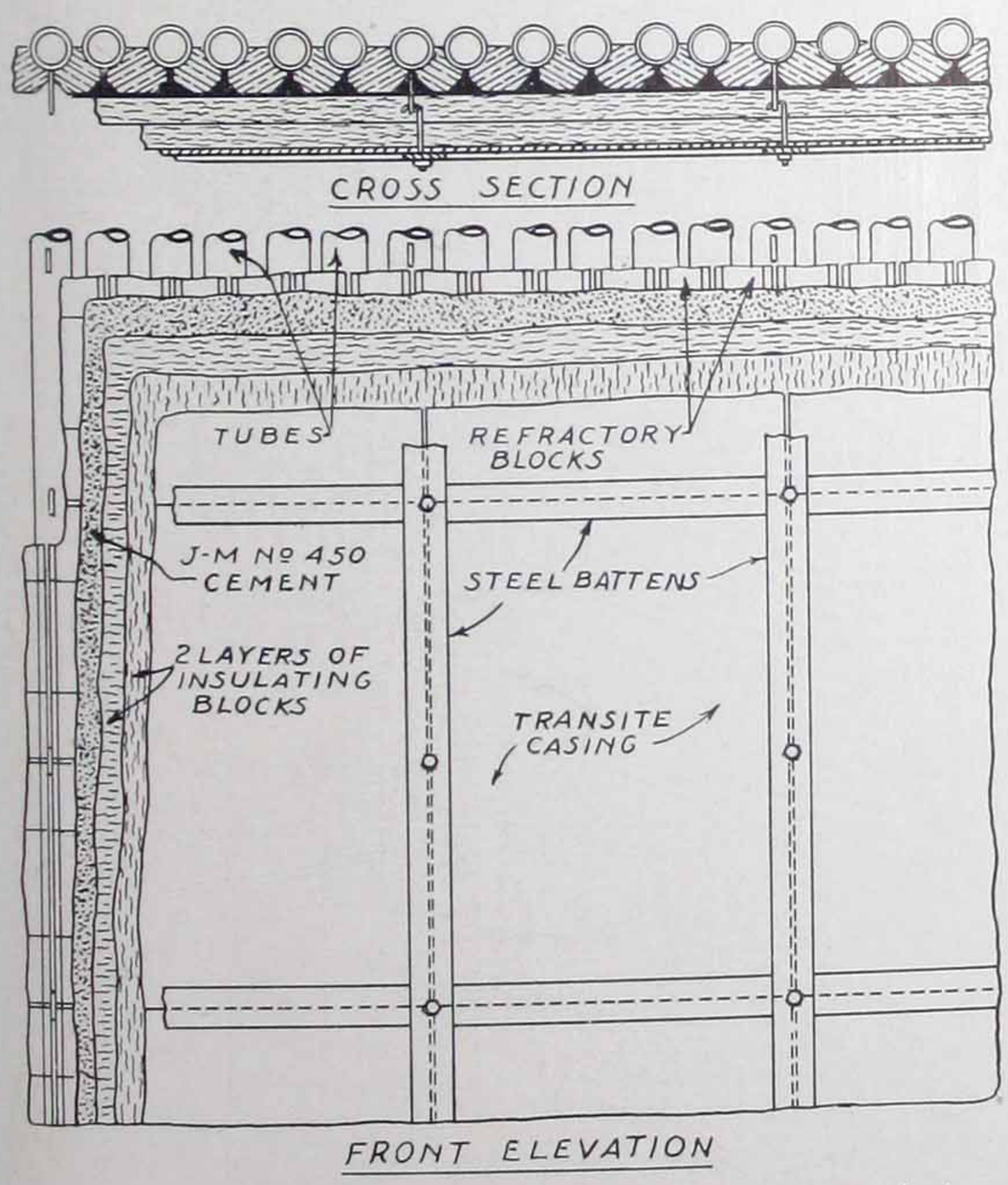
Water-Wall Insulation and Casing

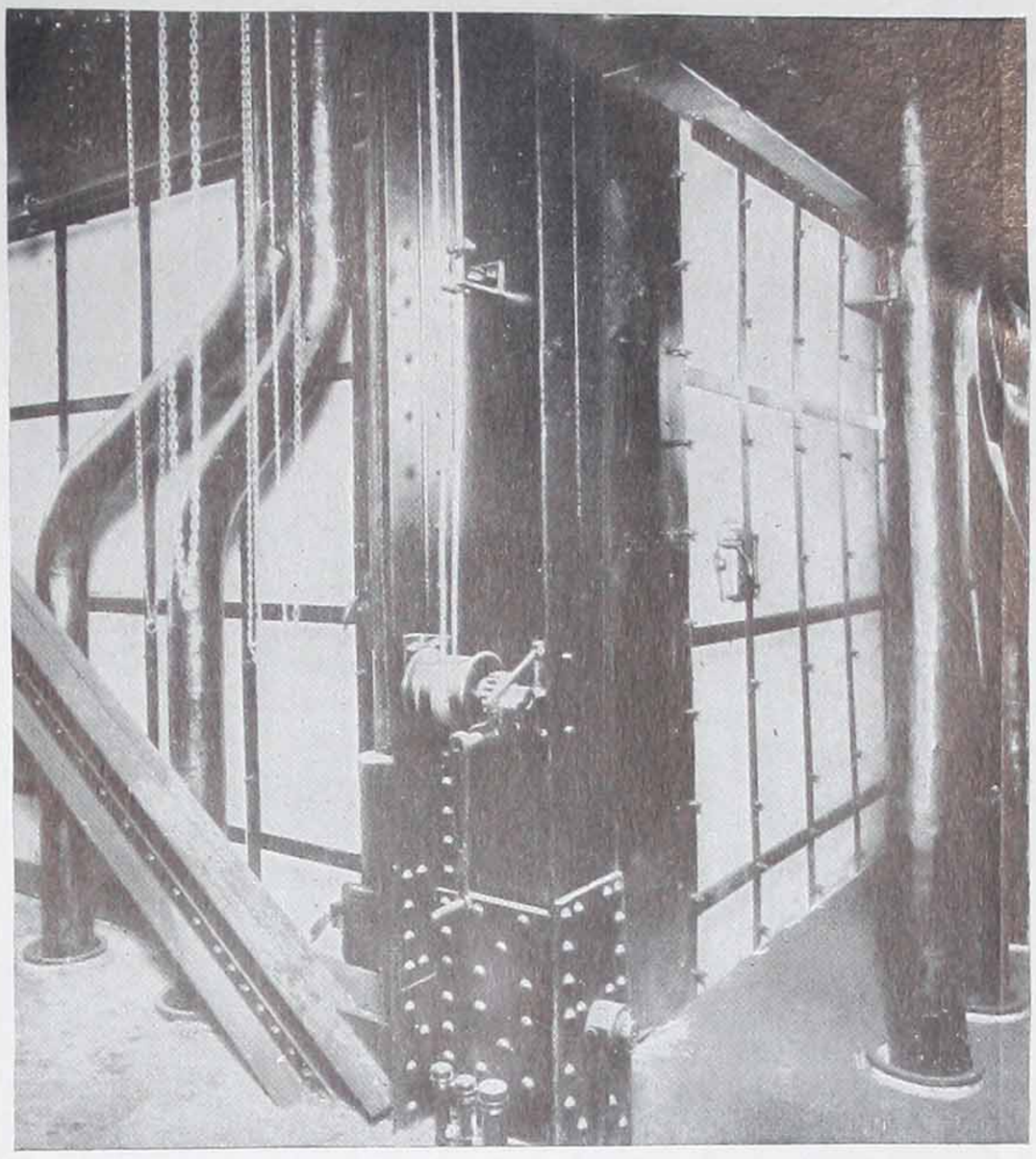
Boiler water walls are insulated with about 4″ of -M 85% Magnesia Blocks, or, if the temperature is ıigh, with Superex or Superex Combination Insula- ion. The insulation is cased with 3/8″ Transite panels, ›attened with steel strips, which makes a neat remov- ıble and replaceable casing of great durability. The ıeat saving resulting from this construction amounts o more than 90 percent of the uninsulated loss.

If the exterior of the wall surface is uneven, a filler :oat of J-M No. 450 Insulating Cement is first well pressed onto the surface in a thickness just sufficient :o provide a flat surface. Then two layers of insu- lating blocks are applied with the lengths of the blocks running vertically and with all joints broken. The outside layer is pointed up with J-M No. 302 In- sulating Cement and all joints are closely butted.

Casing bolts or studs protrude through the insula- tion and serve to support flat Transite panels which are usually fitted against the wall in vertical rows between the bolts, beginning at the bottom. Each panel has a flat steel batten bolted to its top edge, be- hind which the next higher panel is slipped in the course of erection. The panels are secured against the wall by continuous steel battens pressed firmly over their vertical edges and held in place by the wall bolts or studs. Pliable gaskets of J-M Asbestos Roll



General method of providing for water-wall insulation and casing



Bailey water-wall insulation with Transite casing

Fire-Felt may be used under all battens to seal the casing against air infiltration.

No cables or mesh are used with the panel type casing and the construction permits access to the tubes without disturbing the insulation anywhere on the wall except that portion which it is desired to remove. Because of weight, it has been found advisable to support steel casings, where used, independently of the water wall. Cables and lacing wire must then be employed to hold the insulation, which cannot thereby be secured as snugly against the wall as with an integral casing. Flue effect between separate casing and insulation increases loss but creates a false impression of efficiency because the casing is cooled by the air flow. Transite casings have none of these disadvantages.

If reinforced hard finish cement is used instead of Transite, the disadvantages of wire and mesh are present but there are better possibilities of an air seal than with an independently supported steel casing. The cement finish should not be used where it will be subjected to hard wear.

Sometimes No. 450 Insulating Cement is used not merely to level the surface to be insulated but is made thicker to serve as complete insulation either by itself or with a hard reinforced cement finish. The plastic insulation is less efficient than the blocks and the construction in general is less desirable.

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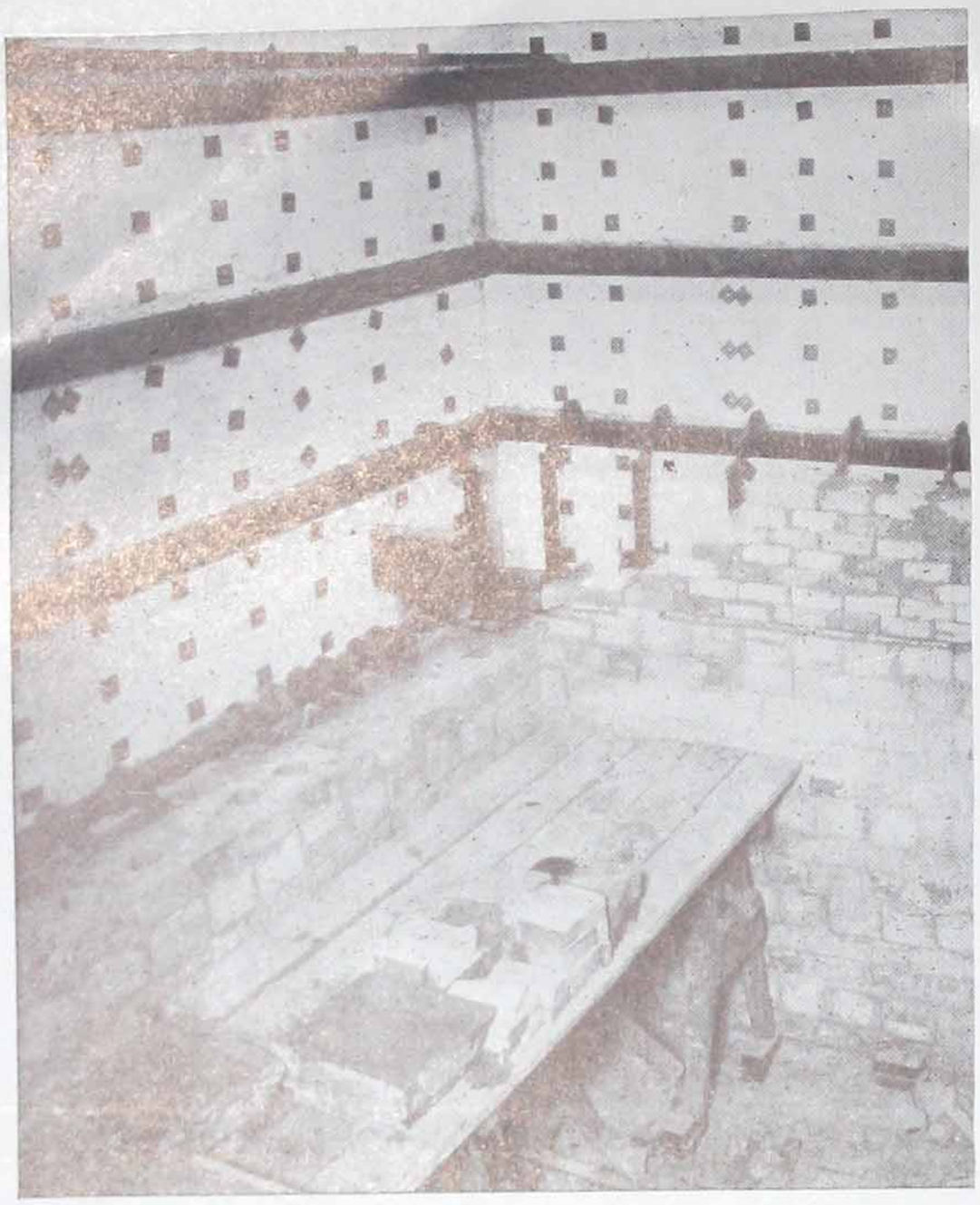


Interior of insulated Transite casing erected outside air-cooled furnace walls. Brickwork is laid after the casing is completed

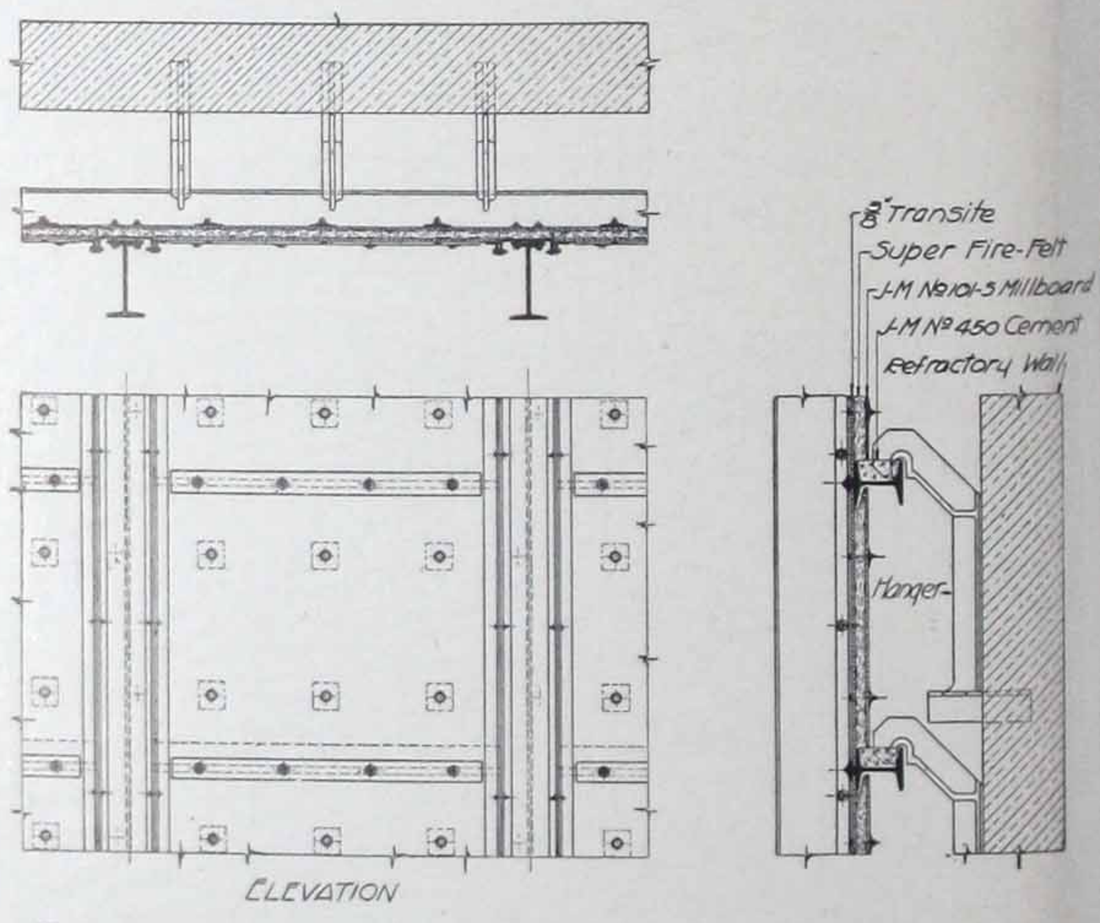
Air-Cooled Wall Insulation and Casing

In all designs of ventilated boiler walls air is drawn over exterior brick surfaces (suspended or otherwise) either by fans, by natural draft or by burner induction. The circulation varies in the different designs, but in all designs the function of the casing over the air passages is to retain the heat recovered by the air, furnish a suitable clearance for air travel so that adequate scrubbing action is combined with the elimination of undue friction loss, and prevent leakage of air which would interrupt the flow over surfaces to be cooled. The construction should be fireproof and able successfully to withstand abrasion, ordinary mechanical impact and high temperature.

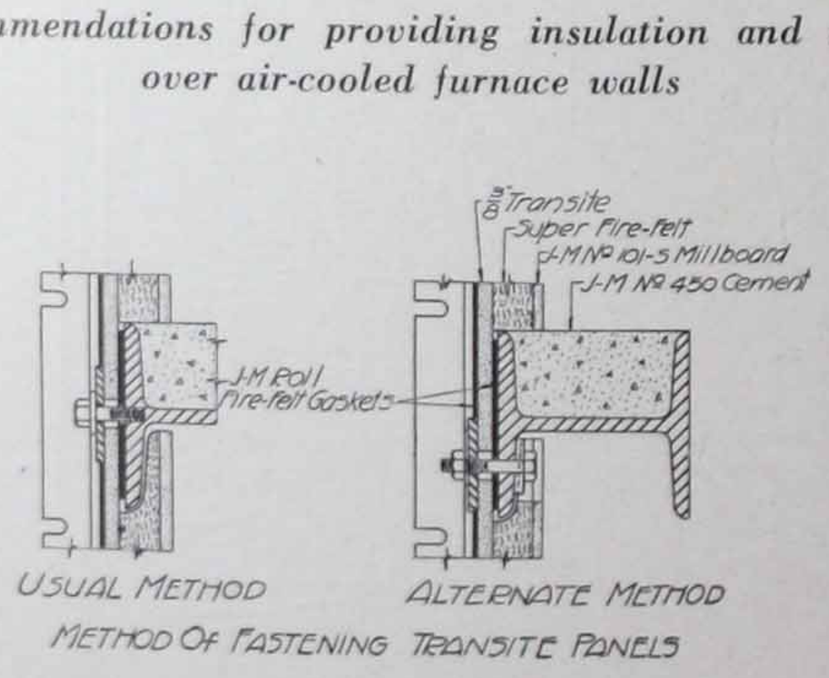
The best casing is made of 3/8″ flat Transite, lined with Super Fire-Felt Sheets (usually 1″ thick). A protective surface, next to the air space, is provided by 1/4″-thick J-M No. 101-S Asbestos Sheet Millboard. This casing, erected between the buckstays, gives superior insulation with minimum thickness. The panel construction is tight, sectionally removable and replaceable, and economical of floor space.

The materials which go to make up the panels are fabricated as units by means of through bolts with nuts on the inside, bearing on large washers pressed against the furnace surface of the millboard. Behind each buckstay the insulation and millboard may be held in place by bolts passing through the flange of the buckstay. If horizontal H-beams are used, their upper half is filled with J-M No. 450 Insulating Cement before the casing is erected.

The usual practice is to complete the application of insulation and casing prior to the erection of the brick furnace walls. In one method of application the panels are maintained in position by steel battens fastened to the horizontal H-beams. In this construction the buckstays are backed up with channels so applied that the legs of the channels extend forward from the casing. Vertical joints along the buckstays, between the buckstays and the casing panels, are sealed by light angles, slotted for bolting to the legs of the channels backing the buckstays and pressed firmly against the panels as a final operation. All joints subject to air leakage are gasketed during erection with 1/8″ J-M Asbestos Roll Fire-Felt.



Recommendations for providing insulation and casing over air-cooled furnace walls



Methods of fastening panels to horizontal beams

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Boiler Bases

The bases of boilers should ordinarily be insulated nder fire brick with at least 4″ of Sil-O-Cel C-3 Concrete. Sil-O-Cel Brick of the proper type to withtand the temperature may be applied where the use f brick shapes is advantageous.

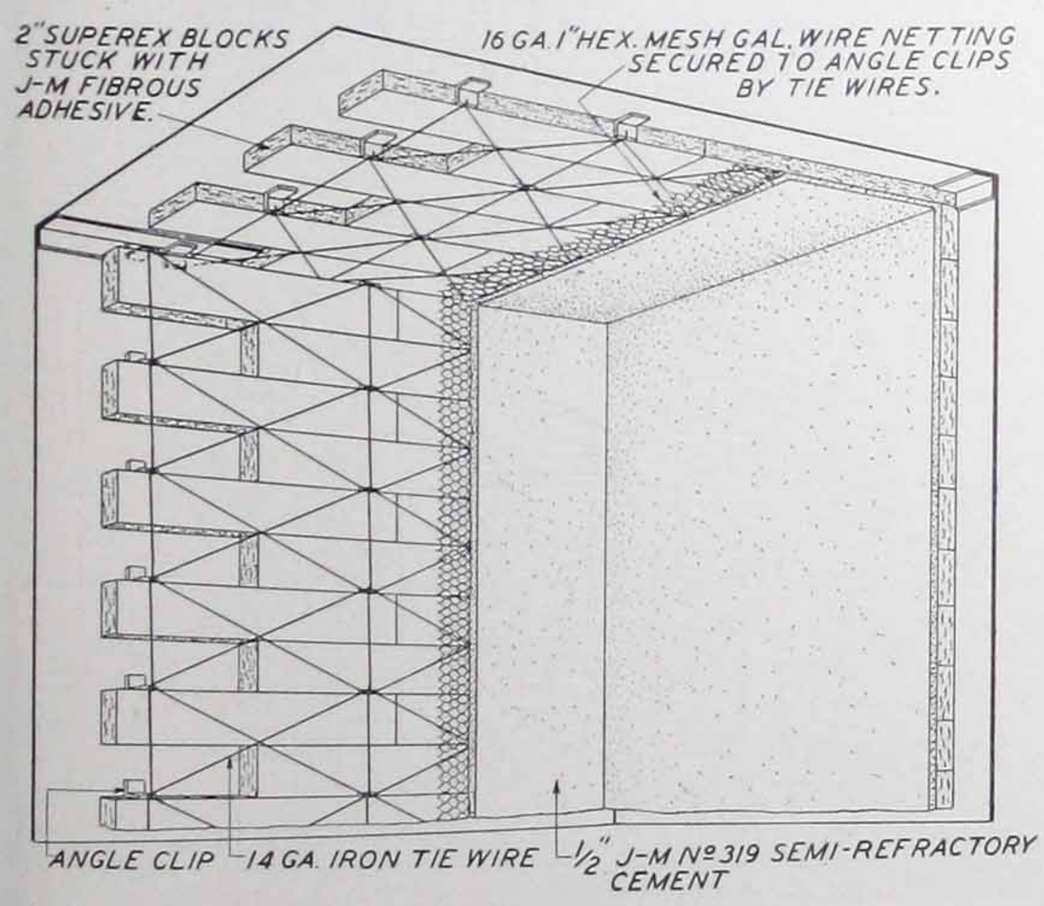
Expansion joints in the brickwork of the base are erhaps even more essential than in the walls, if a atisfactory life is to be obtained. Where improper oints are provided the fire brick will arch and expose he insulation.

In some cases where inadequate insulation is used ver a cinder fill, heat has been known to work down nto the foundation and ignite the cinders if they are ot burned out properly. Where boilers are set over wood piling or in other places where fire hazards are resent, particular care is essential in insulating the ases.

Boiler Tube Doors

Boiler tube doors should be thoroughly insulated o protect the steam surfaces immediately behind. These doors are insulated with 2″ Super Fire-Felt Sheets, protected on the surface with ¼″ J-M No. 101-S Asbestos Sheet Millboard, the whole being held in place by bolts and plate washers. All joints between the sheets and around the edges are pointed up with J-M No. 319 Semi-Refractory Cement.

If the doors are insulated before they are hung, they may be laid flat and filled with Sil-O-Cel C-3 Concrete rammed in between reinforcing bolts which extend through the door.



Breeching lined with Superex Blocks

Boiler breeching lined with 2½″ Sil-O-Cel Natural Brick and Semi-Refractory Cement

Breechings and Stacks

No one doubts the advisability of insulating smoke flues and breechings but there is some difference of opinion as to whether the insulation should be external or internal. Often the size and location of the flue will eliminate one possibility, as where a man cannot work inside and the insulation is necessarily placed outside. Outdoor ducts, on the other hand, should be insulated inside if in any way possible. The special circumstances of the individual installation usually indicate the better kind of construction.

In applying interior insulation, drilled angle clips or other suitable fasteners are spot-welded to the interior of the breeching on convenient centers. Tie wires are twisted through the hole in each clip and the insulation (2½″ Sil-O-Cel Natural Brick or 2″ Superex Blocks) stuck against the shell with J-M Fibrous Adhesive. The insulation is securely laced in position and reinforcing mesh tied tightly over the surface. J-M No. 319 Semi-Refractory Cement is worked well into the reinforcing mesh, and after the first application is dry, the second coat is troweled smooth and hard. This finish is very effective in protecting the insulation from abrasion.

In erecting outside insulation, J-M 85% Magnesia or Superex Blocks may be stuck to the shell, wired in position, and finished with No. 302 Insulating Cement reinforced with wire mesh. In a Connery breeching this construction has the disadvantage of leaving the expansion stiffeners uninsulated.

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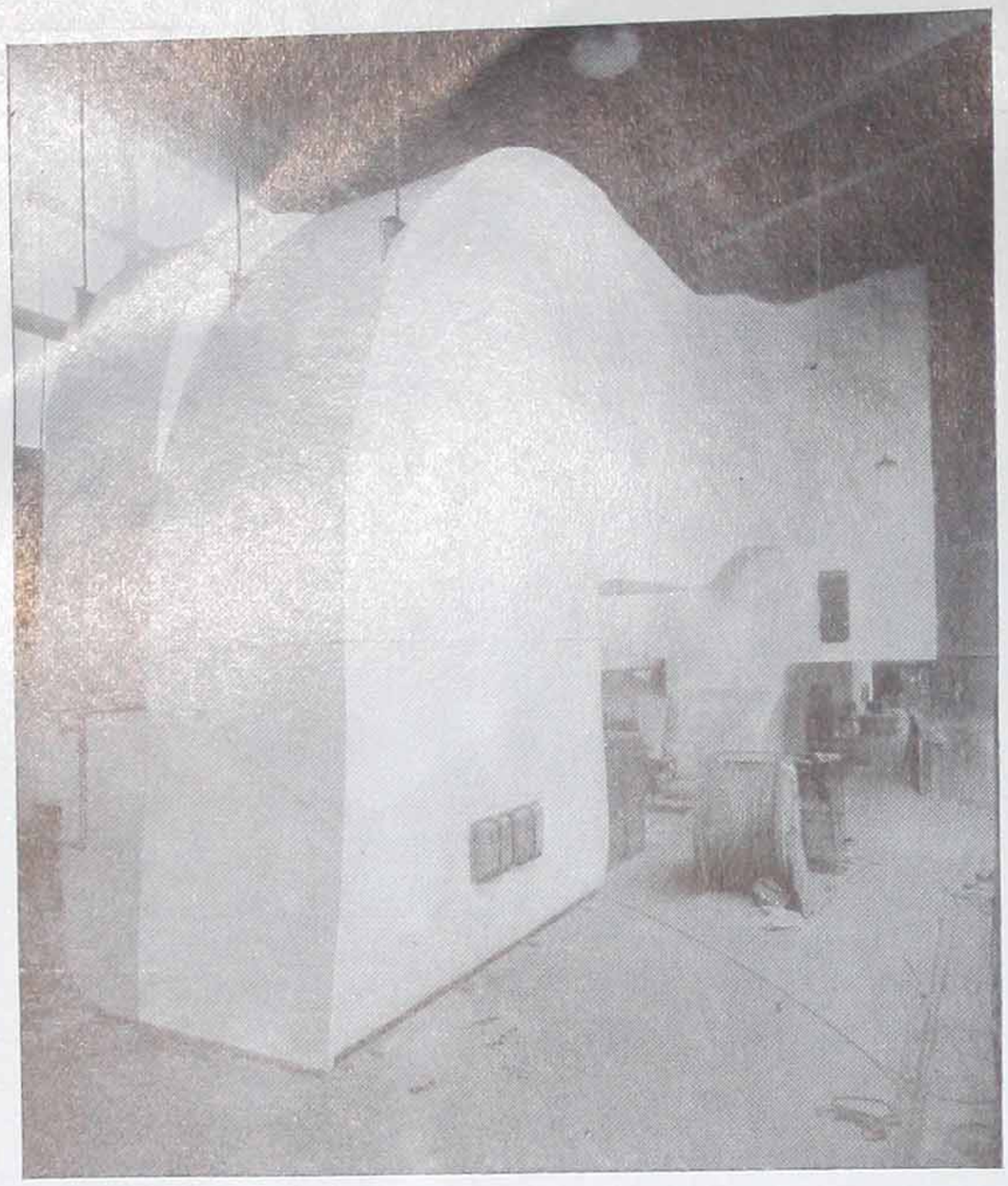
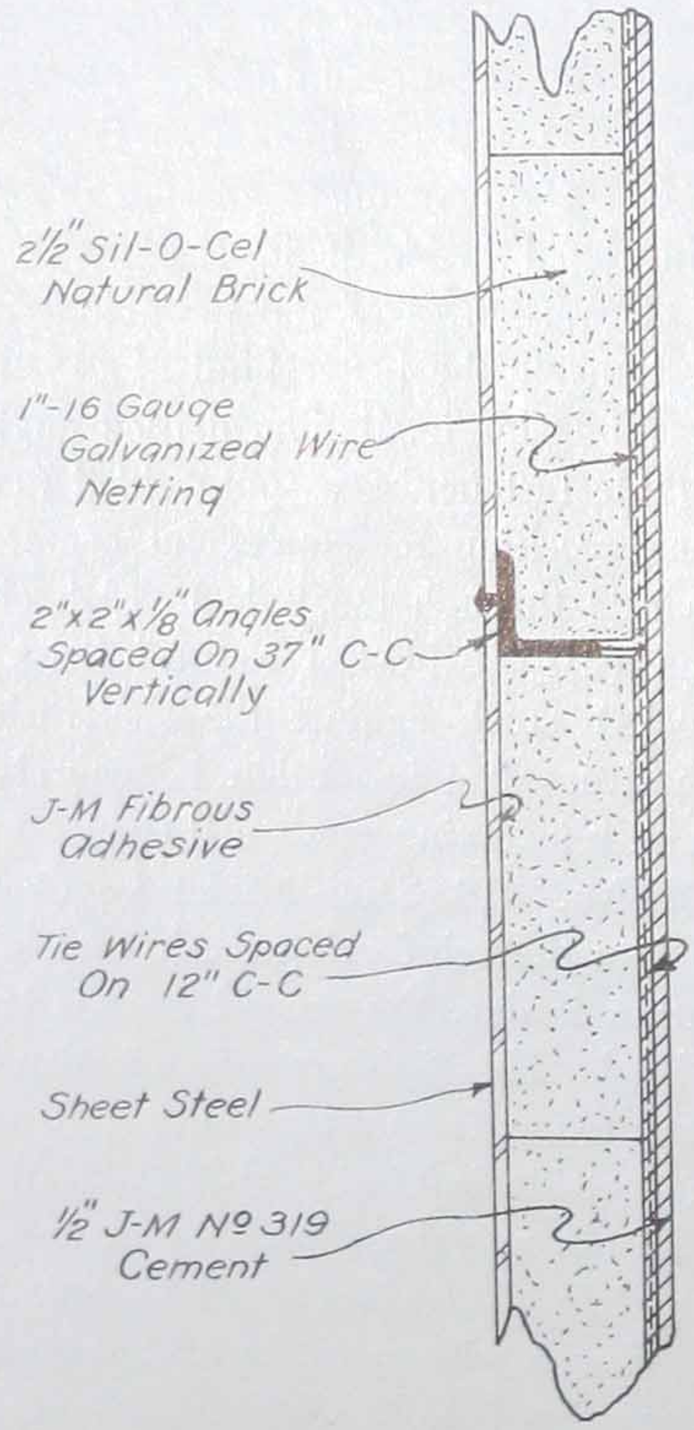


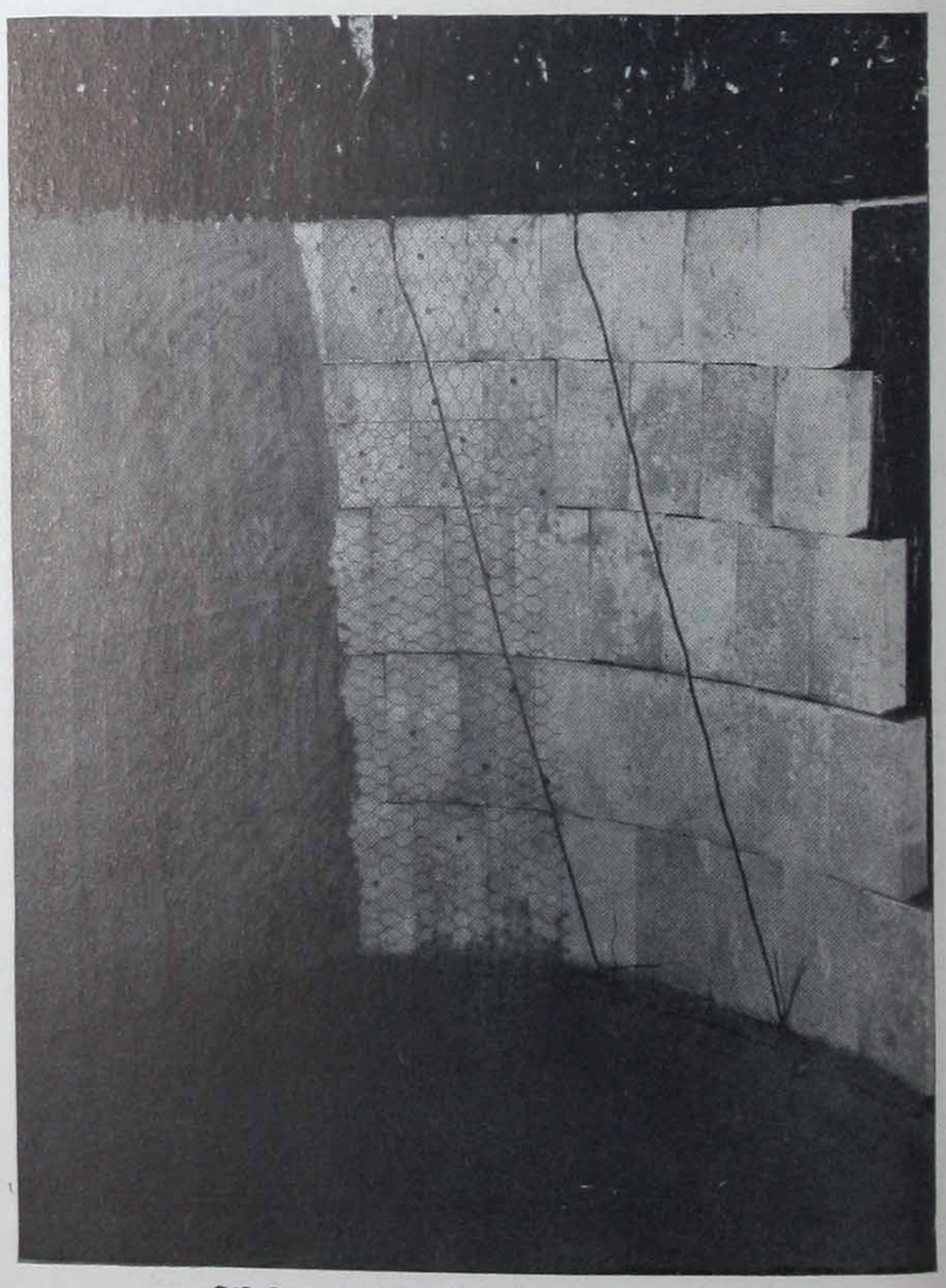
Connery flue insulated with Superex Blocks with cement finish

Another method for outside work is to apply 6″ square mesh 6-gauge wire fabric over the stiffener angles or V-ribs. On Connery flues it is spot-welded to the V-ribs and on other flues it is securely laced to the stiffening angles. The insulating blocks are laced firmly to the fabric with wire and cables, and reinforced No. 302 Cement applied. Where stiffening angles are widely spaced or where there are no projecting stiffeners, V-rib lath with 1″ ribs may be used to form the air space over which block insulation may be applied.

Stacks are insulated in much the same way as the interior of breechings. Circumferential angles 2″ x 2″ x 1/8″ are placed on 37″ vertical centers with 1/4″ holes for lacing punched on 12″ centers in the outstanding leg. Sil-O-Cel Natural Brick are then applied in identical construction to that used on breeching interiors. Sil-O-Cel C-22 Brick are used instead of Natural Brick where stack temperatures are unusually high. Vitribestos Sheets, 2″ thick and curved to fit, are designed for stack insulation where temperatures do not exceed 700 deg. F.



Stack lining with Sil-O-Cel Natural Brick



Sil-O-Cel C-22 Brick stack lining

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Efficiency of Insulation

The efficiency of an insulation is obtained by subtracting the heat loss through the insulation from the heat loss of the uninsulated surface and dividing the difference by the heat loss of the uninsulated surface.

The common unit of heat is the B.t.u. (British thermal unit), which is the quantity of heat required to raise the temperature of one pound of water 1 deg. F., or, to be more exact, a B.t.u. is 1/180 of the heat required to raise the temperature of a pound of pure water from 32 deg. F. to 212 deg. F.

Heat Transmission:

Heat transmission is usually expressed in B.t.u. per square foot, or per linear foot, per degree temperature difference, per hour. The term "conductivity" is often used erroneously where "heat transmission" or "heat loss" is meant.

Conductivity:

Conductivity, like density, is a specific property of a material. Conductivity is usually expressed in B.t.u. per square foot, per 1″ of thickness, per degree temperature difference between surfaces, per hour. However, it is not necessary to have exactly 1″ thick material in order to express its conductivity per inch thick.

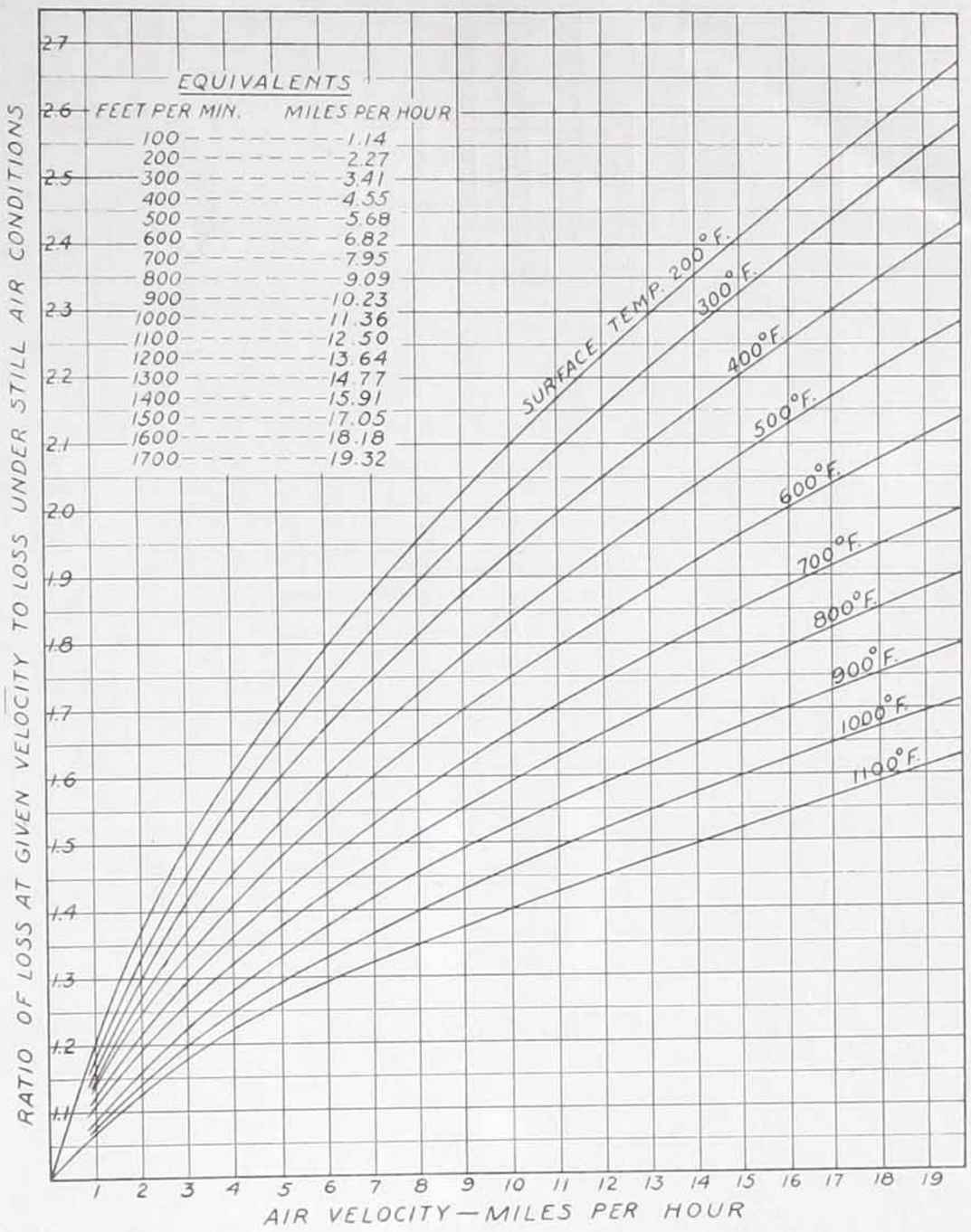
The *rate of heat transmission* is much *less* for a thick layer of a material than it is for a thin layer of the same material, but the *conductivity* is the *same*. This illustrates why the terms "conductivity" and "heat transmission" can not be used interchangeably.

Condensation in Steam Pipes:

Loss of heat from a pipe containing saturated steam does not result in a change in temperature, but causes the condensation of a portion of the steam. In order to determine the amount of condensation it is necessary to divide the total heat loss by the latent heat of evaporation (found in the steam tables).

For example, it will be noted from the steam tables that at 100-lb. gauge pressure the latent heat of evaporation is 879.9 B.t.u. This means, at 100-lb. steam pressure, 1 lb. of condensation for each 879.9 B.t.u. lost.

In case of superheated steam, the loss of heat results in a lowering of the temperature or loss of superheat. Condensation, in the case of superheated steam lines, will not take place until all of the superheat has been dissipated.



Effect of air velocity on bare surface loss. Temperature of air—80 deg. F.

Effect of Wind Velocity:

With a 10-mile per hour wind velocity the heat loss from bare pipe will be 1.5 to 2 times as great as in still air. Higher velocities further increase the loss.

On pipes covered with efficient insulation, the maximum increase in heat loss due to a wind velocity of 30 miles per hour is about 15% for 1″ thick insulation, 10% for 2″ thick insulation and 5% for 3″ thick insulation. At lower velocities there would be a correspondingly lesser effect.

The heat losses and efficiencies shown in data sheet tables are based on still air conditions. The increase in loss from an insulated pipe due to wind velocity is very small compared to the increase in loss from bare pipes, and the thicker the insulation the less the effect of wind in increasing the loss. But, if joints are open or insulation is cracked, so air can circulate, the increase in losses may be many times as great.

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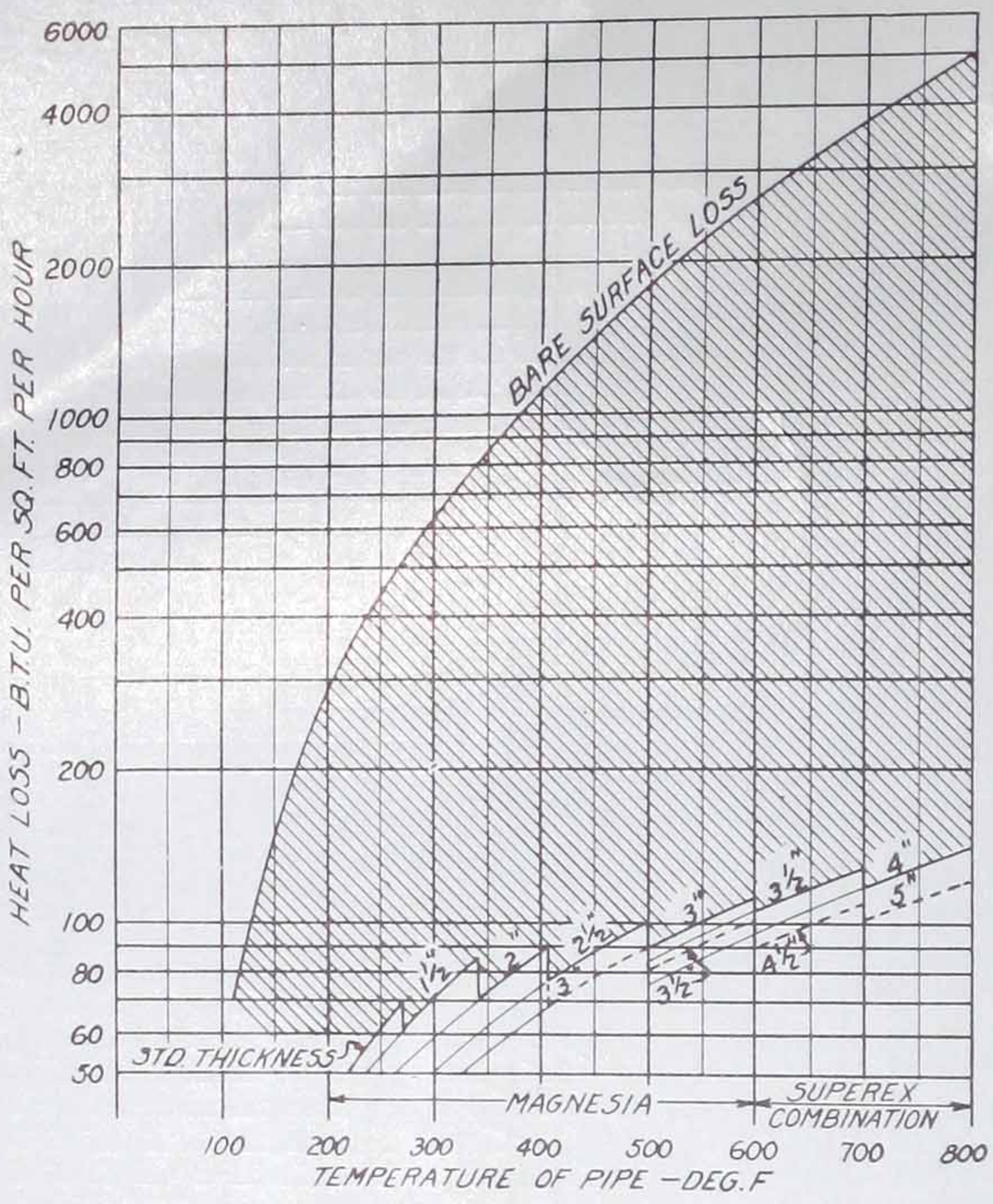

Heat losses through Magnesia and Superex Combination Insulation, on 8″ pipe, compared with bare pipe losses

Efficiency Tables

The efficiencies of pipe insulations vary with the size of the pipe insulated and with the temperature difference between the pipe and the surrounding air.

The efficiencies furnish a means of comparing the savings effected by insulation, with bare pipe losses.

Also the relative values of different insulations may be determined by comparing either their efficiencies or their heat losses. A small difference in efficiency may represent a really large difference in heat losses. The following example will explain further:

The efficiency of 2″ thick Asbesto-Sponge Felted sheet insulation at 500 deg. temperature difference is 95.29% and of the same insulation 3″ thick, 96.75%. The difference in efficiencies is only 1.46%, which seems small and might lead one to believe that it would not pay to use the extra inch of thickness.

However, the loss through the 95.29% efficient insulation is 4.71% of the bare surface loss and the loss through the 96.75% efficient insulation is only 3.25% of the bare surface loss. The difference is 4.71%—3.25%= 1.46%. Therefore, the loss through the 2″ thickness is 1.46 ÷ 3.25=44.9% greater than the loss through the 3″ thick insulation.

Tables of efficiencies of the different insulations on various sized pipes and on flat surfaces at various temperature differences are given in the data sheets on the respective insulations. Such efficiency tables are used as follows:

Example 1:

What is the *efficiency* of J-M Asbesto-Sponge Felted pipe insulation, 2″ thick, on a 6″ pipe conveying steam at 200 lb. gauge pressure through a room where temperature is 70 deg. F.?

To determine the difference between the temperature of steam in the pipe and the temperature of air surrounding the pipe, refer to the steam tables, where the temperature of steam at 200-lb. pressure is found to be 388 deg. F. The temperature of air around the pipe is the room temperature given, 70 deg. F. Therefore, the temperature difference is 318 deg. F.

Next refer to table of efficiencies for 2″ thick Asbesto-Sponge Felted Pipe Insulation. Opposite 6″ pipe size, the efficiency for 350 deg. F. difference is found to be 92.56% and for 300 deg. F. difference, 91.93%. The difference for 50 deg. F. is therefore, .63%.

If difference for 50 deg. F. = 0.63%, then for 1 deg., the difference is .63 ÷ 50 = .0126%. The temperature difference (318 deg.) is 18 deg. more than 300 deg.; so 18 x .0126 = .227%, which, added to 91.93% (efficiency for 300 deg.) = 92.16%, the required efficiency.

Example 2:

To find exactly *how much heat is saved* by applying this 2″ insulation, proceed as follows:

By referring to table giving total heat loss in B.t.u. per linear foot of bare pipe, opposite 6″ pipe size and under 300 deg. difference, the heat loss is found to be 1696 B.t.u. per hour. Under 350 deg. difference the loss is 2201 B.t.u. The difference in loss for the 50 deg. in temperature difference is 2201—1696 = 505 B.t.u. So, for 1 deg. difference, it is 505 ÷ 50 = 10.10 B.t.u.

The temperature difference (318 deg.) is 18 deg. more than 300 deg., so 18 x 10.10 = 181.8 B.t.u., which, added to 1696 (heat loss at 300 deg. difference) = 1877.8 B.t.u., the required total heat loss from 1 lin. ft. of 6″ bare pipe, per hour.

Having obtained the loss for bare pipe, the saving effected by the 2″ Asbesto-Sponge Felted Insulation is obtained by multiplying the total loss, 1877.8 B.t.u., by the efficiency of the insulation, previously found according to Example 1, as 92.16%, or 92.16% x 1877.8 = 1730.6 B.t.u. saved, per lin. ft. per hour, by the insulation.

This result may be compared with the quantities of heat saved by other types or thicknesses of pipe insulation, which quantities may be obtained in similar manner to the above.

Example 3:

If the *heat loss* through this 2″ thick insulation is to be determined, proceed as follows:

Find the efficiency, as outlined in Example 1, which is 92.16%. If the insulation is 92.16% efficient, the per cent bare surface loss which is still lost through insulation is 100 — 92.16 = 7.84%.

Find the bare surface loss, as outlined in Example 2, which is 1877.8 B.t.u. per lin. ft., per hour.

Then the loss through the insulation is 7.84% of 1877.8 B.t.u.=147.2 B.t.u., per lin. ft., per hour.

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Heat loss from bare surfaces

Losses given in B.t.u. per hour, per linear foot of bare pipe at various temperature differences.

(For finding losses at temperatures between those shown, the B.t.u. increments per degree are given in light-face type between the main columns.)

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F.											
		50°		100°		150°		200°		250°		300°	
½	**0.220**	**21.5**	.52	**47.3**	.64	**79.2**	.76	**117.3**	.90	**162.3**	1.06	**215.2**	1.28
¾	**0.275**	**26.8**	.65	**59.2**	.80	**99.0**	.95	**146.6**	1.13	**202.9**	1.32	**269.0**	1.60
1	**0.344**	**33.5**	.81	**74.0**	1.00	**123.8**	1.19	**183.4**	1.41	**253.8**	1.65	**336.4**	2.01
1¼	**0.435**	**42.4**	1.02	**93.6**	1.26	**156.6**	1.51	**231.9**	1.78	**320.9**	2.09	**425.4**	2.54
1½	**0.498**	**48.6**	1.17	**107.2**	1.44	**179.3**	1.72	**265.4**	2.04	**367.4**	2.39	**487.0**	2.90
2	**0.622**	**60.7**	1.46	**133.9**	1.80	**223.9**	2.15	**331.5**	*2.55	**458.9**	2.99	**608.3**	3.63
2½	**0.753**	**73.4**	1.77	**162.1**	2.18	**271.1**	2.61	**401.4**	3.08	**555.6**	3.62	**736.4**	4.39
3	**0.917**	**89.4**	2.16	**197.3**	2.66	**330.1**	3.17	**488.8**	3.76	**676.6**	4.40	**896.8**	5.34
3½	**1.047**	**102.1**	2.46	**225.3**	3.03	**376.9**	3.62	**558.1**	4.29	**772.5**	5.03	**1024.0**	6.10
4	**1.178**	**114.9**	2.77	**253.5**	3.41	**424.1**	4.08	**627.9**	4.82	**869.1**	5.66	**1152.0**	6.88
4½	**1.309**	**127.6**	3.08	**281.7**	3.79	**471.2**	4.53	**697.7**	5.35	**965.1**	6.30	**1280.0**	7.64
5	**1.456**	**142.0**	3.43	**313.3**	4.22	**524.2**	5.04	**776.1**	5.96	**1074.0**	7.00	**1424.0**	8.48
6	**1.734**	**169.1**	4.08	**373.2**	5.02	**624.2**	6.00	**924.2**	7.10	**1279.0**	8.34	**1696.0**	10.10
7	**1.996**	**194.6**	4.70	**429.5**	5.78	**718.6**	6.91	**1064.0**	8.18	**1473.0**	9.58	**1952.0**	11.64
8	**2.257**	**220.1**	5.31	**485.7**	6.54	**812.5**	7.81	**1203.0**	9.24	**1665.0**	10.84	**2207.0**	13.16
9	**2.519**	**245.6**	5.93	**542.1**	7.29	**906.8**	8.72	**1343.0**	10.32	**1859.0**	12.10	**2464.0**	14.68
10	**2.817**	**274.7**	6.63	**606.2**	8.16	**1014.0**	9.76	**1502.0**	11.52	**2078.0**	13.54	**2755.0**	16.42
11	**3.073**	**299.6**	7.23	**661.3**	8.89	**1106.0**	10.64	**1638.0**	12.58	**2267.0**	14.76	**3005.0**	17.92
12	**3.338**	**325.5**	7.86	**718.3**	9.67	**1202.0**	11.54	**1779.0**	13.68	**2463.0**	16.04	**3265.0**	19.16
14 o.d.	**3.663**	**357.1**	8.62	**788.3**	10.61	**1319.0**	12.66	**1952.0**	15.02	**2703.0**	17.58	**3582.0**	21.36
16 o.d.	**4.188**	**408.3**	9.86	**901.3**	12.13	**1508.0**	14.48	**2232.0**	17.16	**3090.0**	20.12	**4096.0**	24.42
18 o.d.	**4.716**	**459.8**	11.10	**1015.0**	13.66	**1698.0**	16.32	**2514.0**	19.32	**3480.0**	22.64	**4612.0**	27.50
20 o.d.	**5.235**	**510.4**	12.33	**1127.0**	15.16	**1885.0**	18.10	**2790.0**	21.44	**3862.0**	25.16	**5120.0**	30.52
24 o.d.	**6.286**	**612.9**	14.80	**1353.0**	18.20	**2263.0**	21.74	**3350.0**	25.76	**4638.0**	30.20	**6148.0**	36.64
30 o.d.	**7.854**	**765.8**	18.48	**1690.0**	22.74	**2827.0**	27.18	**4186.0**	32.18	**5795.0**	37.72	**7681.0**	45.80

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F.											
		350°		400°		450°		500°		550°		600°	
½	**0.220**	**279.3**	1.52	**355.1**	1.73	**441.7**	1.99	**541.2**	2.17	**649.8**	2.45	**772.2**	2.63
¾	**0.275**	**349.1**	1.90	**443.9**	2.16	**552.1**	2.49	**676.5**	2.71	**812.2**	3.06	**965.3**	3.29
1	**0.344**	**436.7**	2.37	**555.2**	2.71	**690.6**	3.11	**846.2**	3.40	**1016.0**	3.82	**1207.0**	4.12
1¼	**0.435**	**552.2**	3.00	**702.1**	3.42	**873.3**	3.93	**1070.0**	4.30	**1285.0**	4.84	**1527.0**	5.20
1½	**0.498**	**632.2**	3.43	**803.8**	3.92	**999.7**	4.51	**1225.0**	4.92	**1471.0**	5.54	**1748.0**	5.96
2	**0.622**	**789.6**	4.29	**1004.0**	4.90	**1249.0**	5.62	**1530.0**	6.14	**1837.0**	6.92	**2183.0**	7.44
2½	**0.753**	**955.9**	5.18	**1215.0**	5.94	**1512.0**	6.80	**1852.0**	7.44	**2224.0**	8.38	**2643.0**	9.00
3	**0.917**	**1164.0**	6.32	**1480.0**	7.22	**1841.0**	8.30	**2256.0**	9.04	**2708.0**	10.22	**3219.0**	10.96
3½	**1.047**	**1329.0**	7.22	**1690.0**	8.24	**2102.0**	9.48	**2576.0**	10.32	**3092.0**	11.66	**3675.0**	12.52
4	**1.178**	**1496.0**	8.10	**1901.0**	9.28	**2365.0**	10.66	**2898.0**	11.62	**3479.0**	13.12	**4135.0**	14.08
4½	**1.309**	**1662.0**	9.02	**2113.0**	10.30	**2628.0**	11.84	**3220.0**	12.92	**3866.0**	14.58	**4595.0**	15.64
5	**1.456**	**1848.0**	10.04	**2350.0**	11.46	**2923.0**	13.18	**3582.0**	14.36	**4300.0**	16.22	**5111.0**	17.40
6	**1.734**	**2201.0**	11.96	**2799.0**	13.64	**3481.0**	15.70	**4266.0**	17.10	**5121.0**	19.30	**6086.0**	20.74
7	**1.996**	**2534.0**	13.76	**3222.0**	15.70	**4007.0**	18.06	**4910.0**	19.68	**5894.0**	22.24	**7006.0**	23.88
8	**2.257**	**2865.0**	15.56	**3643.0**	17.76	**4531.0**	20.42	**5552.0**	22.28	**6666.0**	25.12	**7922.0**	27.00
9	**2.519**	**3198.0**	17.36	**4066.0**	19.82	**5057.0**	22.80	**6197.0**	24.86	**7440.0**	28.04	**8842.0**	30.20
10	**2.817**	**3576.0**	19.42	**4547.0**	22.16	**5655.0**	25.50	**6930.0**	27.80	**8320.0**	31.36	**9888.0**	33.60
11	**3.073**	**3901.0**	21.18	**4960.0**	24.18	**6169.0**	27.82	**7560.0**	30.32	**9076.0**	34.30	**10790.0**	36.60
12	**3.338**	**4238.0**	23.00	**5388.0**	26.26	**6701.0**	30.22	**8212.0**	32.94	**9859.0**	37.20	**11720.0**	39.80
14 o.d.	**3.663**	**4650.0**	25.24	**5912.0**	28.84	**7354.0**	33.14	**9011.0**	36.20	**10820.0**	40.80	**12860.0**	43.80
16 o.d.	**4.188**	**5317.0**	28.84	**6759.0**	32.96	**8407.0**	37.90	**10300.0**	41.40	**12370.0**	46.60	**14700.0**	50.00
18 o.d.	**4.716**	**5987.0**	32.50	**7612.0**	37.10	**9467.0**	40.70	**11600.0**	46.60	**13930.0**	52.40	**16550.0**	56.40
20 o.d.	**5.235**	**6646.0**	36.06	**8449.0**	41.20	**10510.0**	47.40	**12880.0**	51.60	**15460.0**	58.40	**18380.0**	62.60
24 o.d.	**6.286**	**7980.0**	43.40	**10150.0**	49.40	**12620.0**	56.80	**15460.0**	62.20	**18570.0**	69.80	**22060.0**	75.20
30 o.d.	**7.854**	**9971.0**	54.18	**12680.0**	61.80	**15770.0**	71.00	**19320.0**	77.60	**23200.0**	87.40	**27570.0**	93.80

***Example:** 2″ pipe, 235° temp. diff.; 235° − 200° = 35°; 35° × 2.55 (B.t.u. per deg.) = 89.3 B.t.u.
331.5 + 89.3 = 420.8 B.t.u. loss at 235° temperature difference.

(Continued)

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HEAT LOSS FROM BARE SURFACES

Losses given in B.t.u. per hour, per linear foot of bare pipe at various temperature differences.

(For finding losses at temperatures between those shown, the B.t.u. increments per degree are given in light-face type between the main columns.)

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F. 650°		700°		750°		800°		850°		900°
½	0.220	903.8	2.86	1047	3.06	1200	3.28	1364	3.48	1538	3.70	1723
¾	0.275	1130.0	3.58	1309	3.84	1501	4.08	1705	4.36	1923	4.60	2153
1	0.344	1413.0	4.48	1637	4.80	1877	5.12	2133	5.44	2405	5.78	2694
1¼	0.435	1787.0	5.68	2071	6.06	2374	6.46	2697	6.88	3041	7.30	3406
1½	0.498	2046.0	6.50	2371	6.92	2717	7.42	3088	7.88	3482	8.34	3899
2	0.622	2555.0	8.12	2961	8.66	3394	9.24	3856	9.86	4349	10.42	4870
2½	0.753	3093.0	9.82	3584	10.50	4109	11.20	4669	11.90	5264	12.64	5896
3	0.917	3767.0	11.96	4365	12.76	5003	13.64	5685	14.52	6411	15.38	7180
3½	1.047	4301.0	13.66	4984	14.58	5713	15.56	6491	16.58	7320	17.56	8198
4	1.178	4839.0	15.36	5607	16.42	6428	17.52	7304	18.64	8236	19.76	9224
4½	1.309	5377.0	17.08	6231	18.22	7142	19.48	8116	20.72	9152	21.96	10250
5	1.456	5981.0	19.00	6931	20.26	7944	21.66	9027	23.10	10180	24.40	11400
6	1.734	7123.0	22.62	8254	24.14	9461	25.80	10750	27.40	12120	29.20	13580
7	1.996	8200.0	26.02	9501	27.80	10890	29.80	12380	31.60	13960	33.40	15630
8	2.257	9272.0	29.40	10740	31.60	12320	33.40	13990	35.80	15780	37.80	17670
9	2.519	10350.0	32.80	11990	35.00	13740	37.60	15620	39.80	17610	42.20	19720
10	2.817	11570.0	36.80	13410	39.20	15370	42.00	17470	44.40	19690	47.40	22060
11	3.073	12620.0	40.20	14630	42.80	16770	45.60	19050	48.60	21480	51.60	24060
12	3.338	13710.0	43.60	15890	46.40	18210	49.80	20700	52.80	23340	56.00	26140
14 o.d.	3.663	15050.0	47.80	17440	51.00	19990	54.40	22710	58.00	25610	61.40	28680
16 o.d.	4.188	17200.0	54.80	19940	58.20	22850	62.40	25970	66.20	29280	70.20	32790
18 o.d.	4.716	19370.0	61.60	22450	65.60	25730	70.20	29240	74.60	32970	79.20	36930
20 o.d.	5.235	21510.0	68.20	24920	72.80	28560	78.00	32460	82.80	36600	87.80	40990
24 o.d.	6.286	25820.0	82.00	29920	87.60	34300	93.40	38970	99.60	43950	105.40	49220
30 o.d.	7.854	32260.0	102.60	37390	109.20	42850	117.00	48700	124.20	54910	131.80	61500

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F. 950°		1000°
½	0.220	3.90	1918	4.10	2123
¾	0.275	4.88	2397	5.14	2654
1	0.344	6.08	2998	6.44	3320
1¼	0.435	7.72	3792	8.12	4198
1½	0.498	8.84	4341	9.30	4806
2	0.622	11.04	5422	11.60	6002
2½	0.753	13.34	6563	14.08	7267
3	0.917	16.26	7993	17.12	8849
3½	1.047	18.56	9126	19.50	10100
4	1.178	20.90	10270	22.00	11370
4½	1.309	23.20	11410	24.40	12630
5	1.456	25.80	12690	27.20	14050
6	1.734	30.60	15110	32.40	16730
7	1.996	35.40	17400	37.20	19260
8	2.257	40.00	19670	42.20	21780
9	2.519	44.80	21960	47.00	24310
10	2.817	49.80	24550	52.60	27180
11	3.073	54.60	26790	57.40	29660
12	3.338	59.20	29100	62.20	32210
14 o.d.	3.663	65.00	31930	68.40	35350
16 o.d.	4.188	74.20	36500	78.20	40410
18 o.d.	4.716	83.60	41110	88.00	45510
20 o.d.	5.235	92.80	45630	97.80	50520
24 o.d.	6.286	111.40	54790	117.40	60660
30 o.d.	7.854	139.20	68460	146.60	75790

Flat, Curved and Cylindrical Surfaces

Heat losses given in B.t.u. per hour, per square foot of bare surface, at various temperature differences.

Temp. difference, degrees F.	Total heat loss at temp. indicated	Increments per degree for total losses	Loss per degree temp. difference
50	97.5		1.950
		2.35	
100	215.2		2.152
		2.90	
150	360.0		2.400
		3.46	
200	533.0		2.665
		4.10	
250	737.8		2.951
		4.80	
300	978.0		3.260
		5.83	
350	1269.5		3.627
		6.89	
400	1614.0		4.035
		7.87	
450	2007.5		4.461
		9.05	
500	2460.0		4.920
		9.87	
550	2953.5		5.370
		11.10	
600	3510.0		5.850
		11.96	
650	4108.0		6.320
		13.04	
700	4760.0		6.800
		13.93	
750	5456.3		7.275
		14.87	
800	6200.0		7.750
		15.83	
850	6991.3		8.225
		16.77	
900	7830.0		8.700
		17.73	
950	8716.3		9.175
		18.67	
1000	9650.0		9.650

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Dimensions of Standard Wrought Iron and Steel Pipe

Diameter			Nominal thickness, inches	Circumference		Transverse area			Length pipe per sq. ft.		Length of pipe containing 1 cu. ft., feet	Nominal weight per ft., pounds	Number of threads per inch	Area of external surface per linear foot, sq. ft.
Nominal internal, inches	Actual external, inches	Actual internal, inches		External, inches	Internal, inches	External, square inches	Internal, square inches	Metal, square inches	External surface, feet	Internal surface, feet				
1/8	.405	.269	.068	1.272	.845	.129	.057	.0717	9.431	14.199	2533.000	.244	27	.106
1/4	.540	.364	.088	1.696	1.144	.229	.104	.1249	7.075	10.490	1383.300	.420	18	.141
3/8	.675	.493	.091	2.121	1.549	.358	.191	.1670	5.657	7.747	754.300	.567	18	.177
1/2	.840	.622	.109	2.639	1.954	.554	.304	.2500	4.547	6.141	473.900	.850	14	.220
3/4	1.050	.824	.113	3.299	2.589	.966	.533	.3327	3.637	4.635	270.000	1.115	14	.275
1	1.315	1.049	.133	4.131	3.296	1.358	.864	.4940	2.904	3.641	166.600	1.678	11½	.344
1¼	1.660	1.380	.140	5.215	4.333	2.164	1.496	.6680	2.301	2.768	96.250	2.244	11½	.435
1½	1.900	1.610	.145	5.969	5.058	2.835	2.036	.7990	2.010	2.372	70.730	2.717	11½	.498
2	2.375	2.067	.154	7.461	6.494	4.430	3.356	1.0740	1.608	1.848	42.910	3.609	11½	.622
2½	2.875	2.469	.203	9.032	7.757	6.492	4.788	1.7040	1.328	1.547	30.070	5.793	8	.753
3	3.500	3.068	.216	10.996	9.638	9.621	7.393	2.2280	1.091	1.245	19.470	7.575	8	.917
3½	4.000	3.548	.226	12.566	11.146	12.566	9.887	2.6790	.955	1.077	14.570	9.001	8	1.047
4	4.500	4.026	.237	14.137	12.648	15.904	12.730	3.1740	.849	.949	11.310	10.665	8	1.178
4½	5.000	4.506	.247	15.708	14.156	19.635	15.947	3.6880	.763	.847	9.030	12.538	8	1.309
5	5.563	5.047	.258	17.477	15.856	24.306	20.006	4.3000	.686	.756	7.198	14.671	8	1.456
6	6.625	6.065	.280	20.813	19.054	34.472	28.888	5.5840	.577	.630	4.980	18.762	8	1.734
7	7.625	7.023	.301	23.955	22.063	45.664	38.738	6.9260	.501	.544	3.720	23.271	8	1.996
8	8.625	7.981	.322	27.096	25.073	58.426	50.027	8.3990	.442	.478	2.878	28.544	8	2.257
9	9.625	8.941	.342	30.238	28.089	72.760	62.786	9.9740	.396	.427	2.294	33.907	8	2.519
10	10.750	10.020	.365	33.772	31.479	90.763	78.855	11.9080	.355	381	1.826	40.483	8	2.817
11	11.750	11.000	.375	39.914	34.558	108.434	95.033	13.4010	.325	.347	1.510	45.028	8	3.073
12	12.750	12.000	.375	40.055	37.700	127.677	113.098	14.5790	.299	.319	1.270	48.985	8	3.337
14 O. D.	14.000	13.250	.375	43.982	41.626	153.938	137.887	16.0510	.273	.288	1.040	54.560	8	3.663
16 O. D.	16.000	15.250	.375	50.266	47.909	201.062	182.655	18.4070	.239	.250	.750	62.570	8	4.188
18 O. D.	18.000	17.250	.375	56.549	54.193	254.470	233.253	21.2170	.212	.221	.620	70.580	8	4.716
20 O. D.	20.000	19.250	.375	62.832	60.476	314.159	291.040	23.1190	.191	.198	.495	78.590	8	5.235
22 O. D.	22.000	21.250	.375	69.115	66.759	380.134	354.657	25.4770	.174	.180	.406	86.600	8	5.747
24 O. D.	24.000	23.250	.375	75.398	73.042	452.390	424.558	27.8320	.159	.164	.340	94.610	8	6.286

Some Properties of Saturated Steam

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Gauge* press. lb.	Absol. press. lb.	Temp. deg. F.	Sp. Vol. cu. ft. per lb.	Latent heat of evap.	Total heat of steam
....	0.2	53.14	1526.00	1063.8	1085.0
....	0.5	79.58	641.40	1048.8	1096.4
....	1.0	101.74	333.60	1036.3	1106.0
....	2.0	126.08	173.73	1022.2	1116.2
....	3.0	141.48	118.71	1013.2	1122.6
....	4.0	152.97	90.63	1006.4	1127.3
....	5.0	162.24	73.52	1001.0	1131.1
....	6.0	170.06	61.98	996.2	1134.2
....	8.0	182.86	47.34	988.5	1139.3
....	10.0	193.21	38.42	982.1	1143.3
....	14.0	209.56	28.04	971.9	1149.5
.0	14.696	212.00	26.80	970.3	1150.4
.3	15	213.03	26.290	969.7	1150.8
5.3	20	227.96	20.089	960.1	1156.3
10.3	25	240.07	16.303	952.1	1160.6
15.3	30	250.33	13.746	945.3	1164.1
20.3	35	259.28	11.898	939.2	1167.1
25.3	40	267.25	10.498	933.7	1169.7
30.3	45	274.44	9.401	928.6	1172.0
35.3	50	281.01	8.515	924.0	1174.1
40.3	55	287.07	7.787	919.6	1175.9
45.3	60	292.71	7.175	915.5	1177.6
50.3	65	297.97	6.655	911.6	1179.1
55.3	70	302.92	6.206	907.9	1180.6
60.3	75	307.60	5.816	904.5	1181.9
65.3	80	312.03	5.472	901.1	1183.1
70.3	85	316.25	5.168	897.8	1184.2
75.3	90	320.27	4.896	894.7	1185.3
80.3	95	324.12	4.652	891.7	1186.2
85.3	100	327.81	4.432	888.8	1187.2
90.3	105	331.36	4.232	886.0	1188.1
95.3	110	334.77	4.049	883.2	1188.9
100.3	115	338.07	3.882	880.6	1189.7
105.3	120	341.25	3.728	877.9	1190.4
110.3	125	344.33	3.587	875.4	1191.1
115.3	130	347.32	3.455	872.9	1191.7
120.3	135	350.21	3.333	870.6	1192.4
125.3	140	353.02	3.220	868.2	1193.0
130.3	145	355.76	3.114	865.8	1193.5
135.3	150	358.42	3.015	863.6	1194.1
145.3	160	363.53	2.834	859.2	1195.1
155.3	170	368.41	2.675	854.9	1196.0
165.3	180	373.06	2.532	850.8	1196.9
175.3	190	377.51	2.404	846.8	1197.6
185.3	200	381.79	2.288	843.0	1198.4
210.3	225	391.79	2.0422	833.8	1199.9
235.3	250	400.95	1.8438	825.1	1201.1
260.3	275	409.43	1.6804	816.9	1202.1
285.3	300	417.33	1.5433	809.0	1202.8
335.3	350	431.72	1.3260	794.2	1203.9
385.3	400	444.59	1.1613	780.5	1204.5
435.3	450	456.28	1.0320	767.4	1204.6
485.3	500	467.01	0.9278	755.0	1204.4
585.3	600	486.21	0.7698	731.6	1203.2
685.3	700	503.10	0.6554	709.7	1201.2
785.3	800	518.23	0.5687	688.9	1198.6
885.3	900	531.98	0.5006	668.8	1195.4
985.3	1000	544.61	0.4456	649.4	1191.8
1235.3	1250	572.42	0.3450	602.4	1181.0
1485.3	1500	596.23	0.2765	556.3	1167.9
1985.3	2000	635.82	0.1878	463.4	1135.1
2485.3	2500	668.13	0.1307	360.5	1091.1
2985.3	3000	695.36	0.0858	217.8	1020.3
3191.5	3206.2	705.40	0.0503	0	902.7

*Gauge pressures are indicated to the nearest tenth of a pound at "sea level" (one standard atmosphere = 14.696 lb. per sq. in.). The authors' tables do not include a column of gauge pressures.

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Total Radiation Areas of Fittings*

Standard flanged fittings

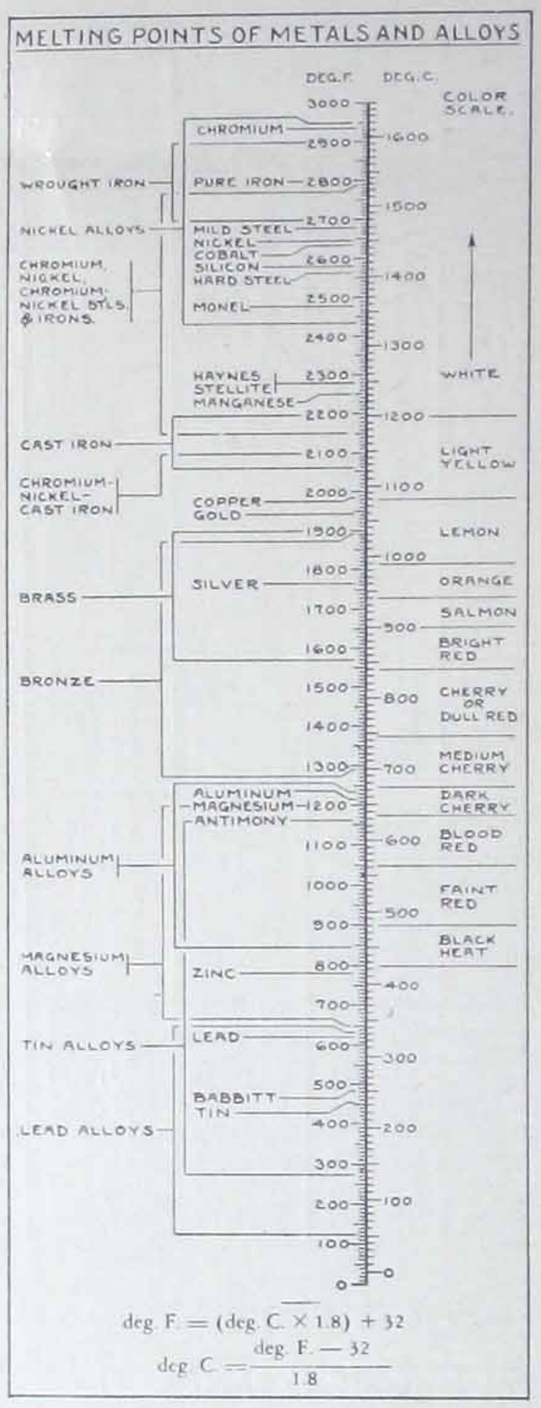
Nominal pipe size	Flanged coupling	90-degree ell	Long-radius ell	Tee	Cross
	Equivalent pipe length in linear feet				
1″	0.93	2.31	2.59	3.59	4.72
1¼″	0.88	2.20	2.49	3.40	4.47
1½″	0.95	2.35	2.68	3.64	4.78
2″	1.08	2.65	2.96	4.08	5.34
2½″	1.12	2.78	3.08	4.26	5.56
3″	1.03	2.60	2.93	3.99	5.70
3½″	1.07	2.85	3.13	4.28	5.56
4″	1.14	2.90	3.36	4.59	5.97
4½″	1.13	3.01	3.38	4.63	6.01
5″	1.11	3.049	3.43	4.67	6.06
6″	1.049	2.950	3.45	4.53	5.81
7″	1.097	3.090	3.697	4.69	6.01
8″	1.067	3.090	3.790	4.67	5.96
9″	1.190	3.457	4.200	5.23	6.66
10″	1.220	3.610	4.380	4.47	6.95
12″	1.320	3.920	4.900	5.89	7.45
14″ O.D.	1.465	4.470	5.470	6.78	8.60
15″ O.D.	1.572	4.720	5.830	7.10	9.04
16″ O.D.	1.600	4.820	6.070	7.23	9.15

Extra heavy flanged fittings

1″	1.273	2.950	3.148	4.578	6.020
1¼″	1.172	2.524	3.080	4.425	5.816
1½″	1.459	2.674	3.762	5.381	7.108
2″	1.363	3.230	3.473	4.968	6.528
2½″	1.463	3.410	3.665	5.378	6.865
3″	1.619	3.807	4.080	5.815	7.582
3½″	1.570	3.782	4.087	5.768	7.535
4″	1.624	3.938	4.236	6.001	7.843
4½″	1.558	3.834	4.170	5.897	7.692
5″	1.497	3.756	4.134	5.851	7.534
6″	1.603	4.031	4.475	6.136	7.929
7″	1.733	4.318	4.874	6.177	8.431
8″	1.670	4.324	4.913	6.531	8.405
9″	1.762	4.541	5.228	6.840	8.773
10″	1.846	4.820	5.538	7.245	9.322
12″	2.010	5.310	5.622	7.987	10.222
14″ O.D.	2.260	6.080	7.020	9.180	11.750
15″ O.D.	2.430	6.430	7.470	9.680	12.400
16″ O.D.	2.400	6.475	7.575	9.775	12.500

* Figures indicate number of linear feet of pipe having an area equivalent to that of the fittings. Area calculated includes accompanying flanges.

Industrial Temperature Data



Temp.	Heating Process
	Above 2000 Deg. F.
2800	Melting Refined Steel
2600	Porcelain Burning
	Melting Heat-Resisting Glass
2550	Burning Fire Brick
2500	Welding Steel Tubes
2450	Copper Refining
2400	Forging Mild Steel
2300	Melting Copper and Bronze
	Melting Lead Glass
2250	Billet and Rivet Heating
2200	Brass Melting
2100	High Speed Steel Hardening
	Below 2000 Deg. F.
1900	Brazing
1850	Vitrification of Sewer Pipe
1800	Blue Annealing Sheets
	Stainless Steel
1700	Vitreous Enameling
	Glazing China
1650	Carburizing
	Lead Hardening
	Annealing Steel Castings
1600	Annealing Springs
1500	Annealing Dies
	Porcelain Enameling
	Hardening Carbon Steel
1450	Annealing Malleable Castings
	Annealing Rolled Steel
1400	Annealing Nickel
	Annealing Hi-Carbon Steel
1300	Annealing Band Steel
	Annealing Wire
1200	Aluminum Melting
	Glass Annealing
1100	Tempering Hi-Speed Steel
	Annealing Nickel Silverware
1000	Annealing Glass Lenses
	Reducing Iron Ore

Melting points shown in chart as single temperatures are for elements. Alloys have a range of melting points due to variable composition.

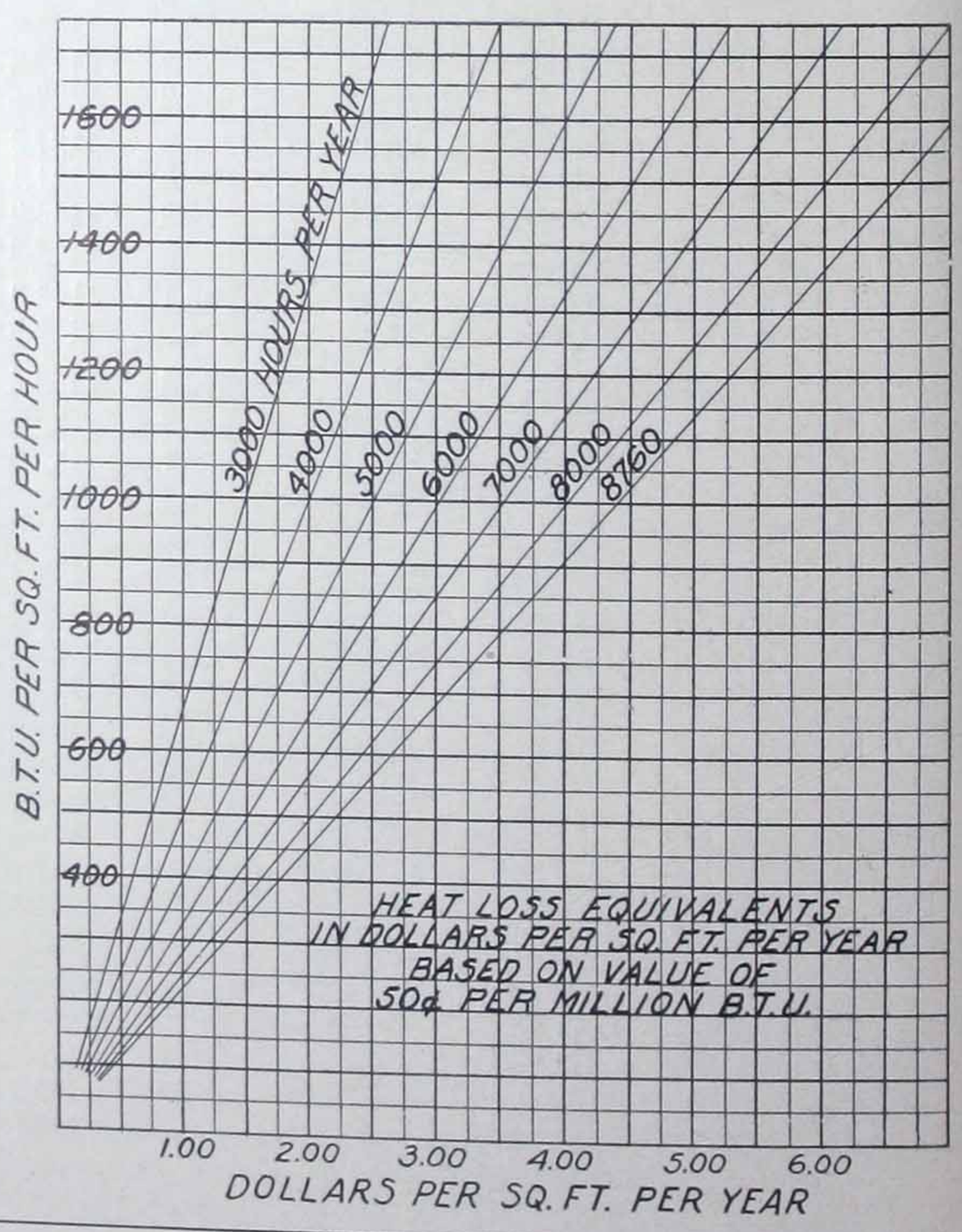
Coal Wasted by Heat Loss from Uninsulated Surfaces

Steam pressure	Temperature (deg. F.)	Temp. Diff. (deg. F.)	B.t.u. Loss per sq. ft. per hour	Coal Wasted, lb. per sq. ft. per year	Area in sq. ft. wasting 1 ton coal in 1 year
0	100	30	56.6	49.6	40.3
0	120	50	97.5	85.4	23.4
0	140	70	142	124.3	16.1
0	160	90	190	166.3	12.03
0	180	110	242	212	9.44
0	200	130	298.5	261.5	7.65
0	212	142	334	293	6.82
10	240	170	425	372	5.38
25	267	197	522.5	458	4.37
50	298	228	644	564	3.55
75	320	250	737.5	646	3.10
100	338	268	820	718	2.79
150	366	296	960	840	2.38
200	388	318	1,079	945	2.12
250	406	336	1,184	1,036	1.93

The table shows the amount of heat energy lost, and coal consequently wasted, by the dissipation of heat through uninsulated surfaces. The calculations are based upon an available heat value per pound of coal of 10,000 B.t.u., which is equivalent to a boiler efficiency of 70 percent using coal with a calorific value of approximately 14,000 B.t.u. per pound.

The figures are based also on continuous service, 24 hours per day, 365 days per year, with the average temperature of surrounding air at 70 deg. F.

These computations are very conservative, as both the boiler efficiency and the heat value of the coal are high; a lesser boiler efficiency or inferior grade of coal would show even greater waste of fuel.



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Johns-Manville Packing Service

The Johns-Manville line of packings has proved its dependability and economy for all types of industrial service.

Sea Rings, an automatic packing for reciprocating rods, have a surprisingly long life and low friction.

Kearsarge Rod packing for steam, Mogul for valve stems, J-M Flax for hydraulics, Flexible Metallic for centrifugals, Service Sheet for general requirements, Kearsarge Gaskets for boilers, are a few of the well-known standard materials.

Rod, plunger, valve stem, piston, sheet packing and gaskets for any service—every requirement is met by some J-M product specially designed to serve the purpose.

The efficient, economical performance of operating equipment is dependent upon a multitude of factors, but among these no more important group-classification can be selected than that of packings.

Premature failure or shut-down of equipment for repair leads to serious losses which only careful planning can avoid. Standardization of all materials used in maintenance is the one most effective method of assuring maximum operating service and greatest return on equipment investment. Only by such means can the quality and uniformity of maintenance materials be preserved.

Packing Service Plan

The Packing Service Plan, perfected by Johns-Manville, is based on exhaustive study in this field, and is designed to accomplish those very objectives outlined above. The adoption of this plan has been the direct means of saving many thousands of dollars yearly. Indirectly, it has saved countless hours of uncharged time and avoided great quantities of unallocated trouble. The many advantages to be derived have been demonstrated repeatedly and under widely varying conditions. Results have been established from experience gained in general manufacturing plants and specialized industries, both large and small.

In every case where it is employed, Johns-Manville Packing Service reduces the capital tied up in packing stocks, minimizes mistakes in ordering, materially reduces handling and storage costs and provides assurance that the right packing will always be available.

Experience has shown that many users of packing are buying a great many different styles of packing for similar service, depending on the preferences of a number of men in the plant. One packing will often serve several of these uses better than the many styles. Instead of a hit-and miss selection, the right packing can be definitely determined and checked by thorough follow-up methods. This is the point at which the J-M Packing Service Plan begins to show a saving.

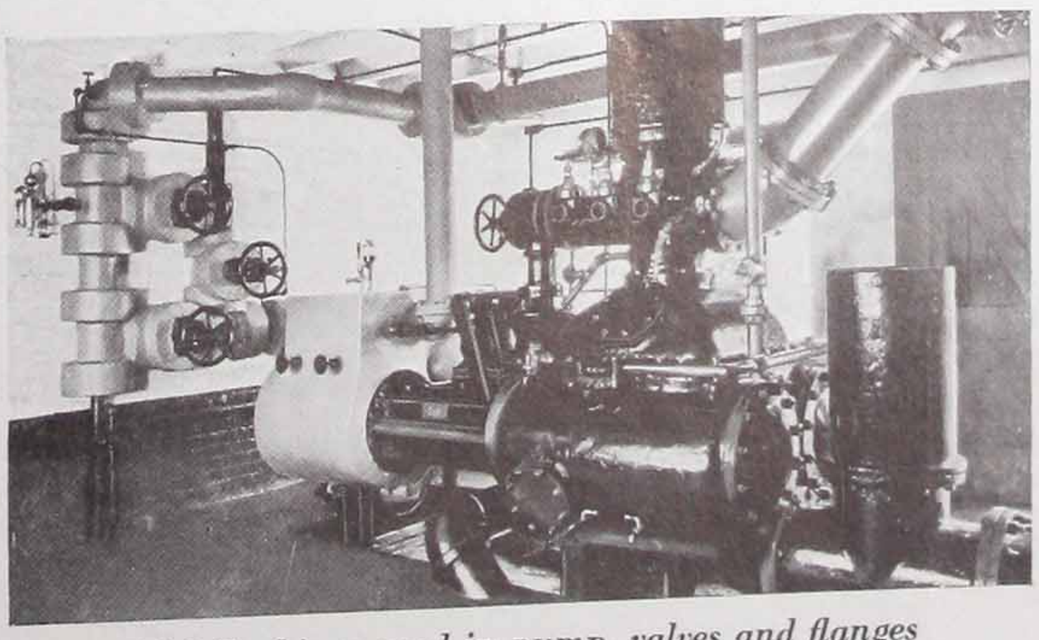
Plant managers are no longer proud of extensive and well-filled stock-rooms, and realize that large store-room stocks are non-productive items of expense which should be cut down. This leads to another advantage of the J-M Plan, which avoids factory ordering and does away with the need of large inventories necessitated by the time required for the manufacturer to make delivery from the factory.

Method of Operation:

The first step in the J-M Packing Service Plan is a detailed survey of individual packing requirements, made by Johns-Manville engineers. Unnecessary duplications are eliminated and improper applications are corrected. When the proper styles of packing have been specified, a chart of packing applications is compiled which shows the minimum of types and sizes.

Each stuffing-box is listed, and important features are noted, such as the size of the packing required, character of service, and pressure and temperature conditions. This information is duplicated and distributed to all concerned with the operation of the Packing Service Plan.

When the J-M Plan is installed, it is recommended that costs be figured for the previous year so that a comparison can be



J-M Packings used in pump, valves and flanges

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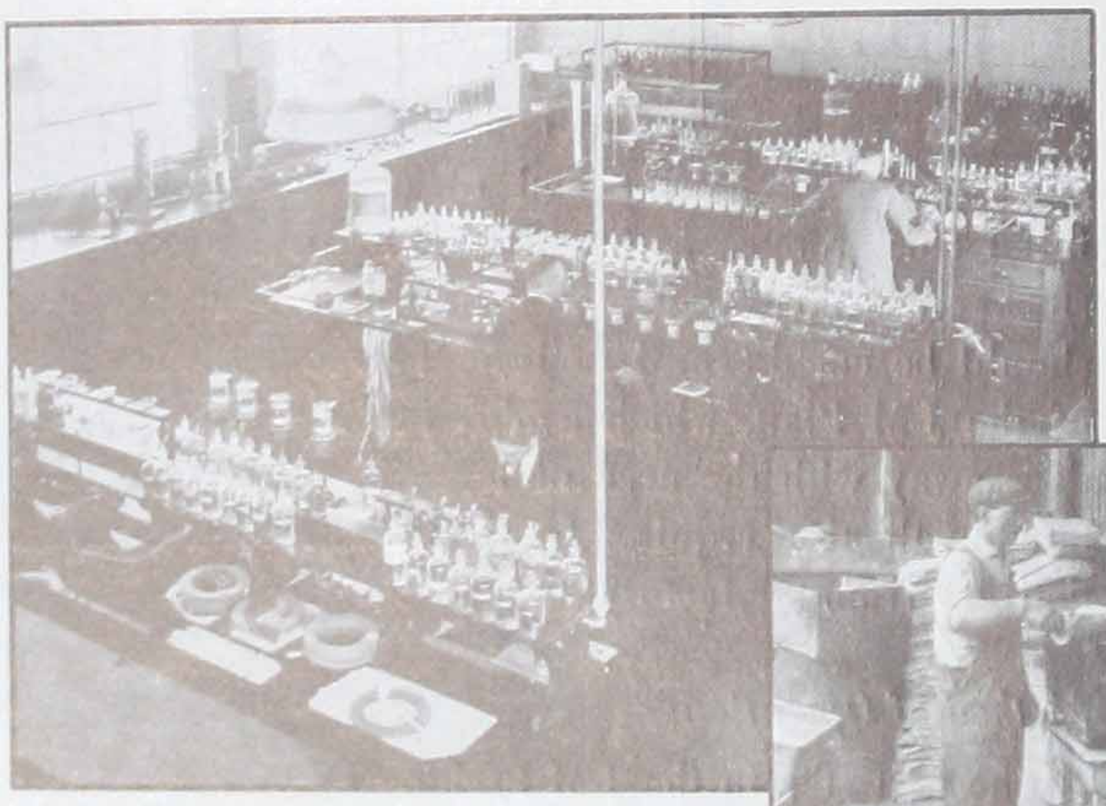
made later. The plant engineer is requested to keep a packing service record showing accurately the materials used and when repacking takes place.

If the record sheet indicates that some item is not giving the proper service, an immediate investigation is made, so that corrective measures can be taken. It may be a scored rod, too tight a gland follower or faulty lubrication. Any such condition can be corrected once attention is focused upon it.

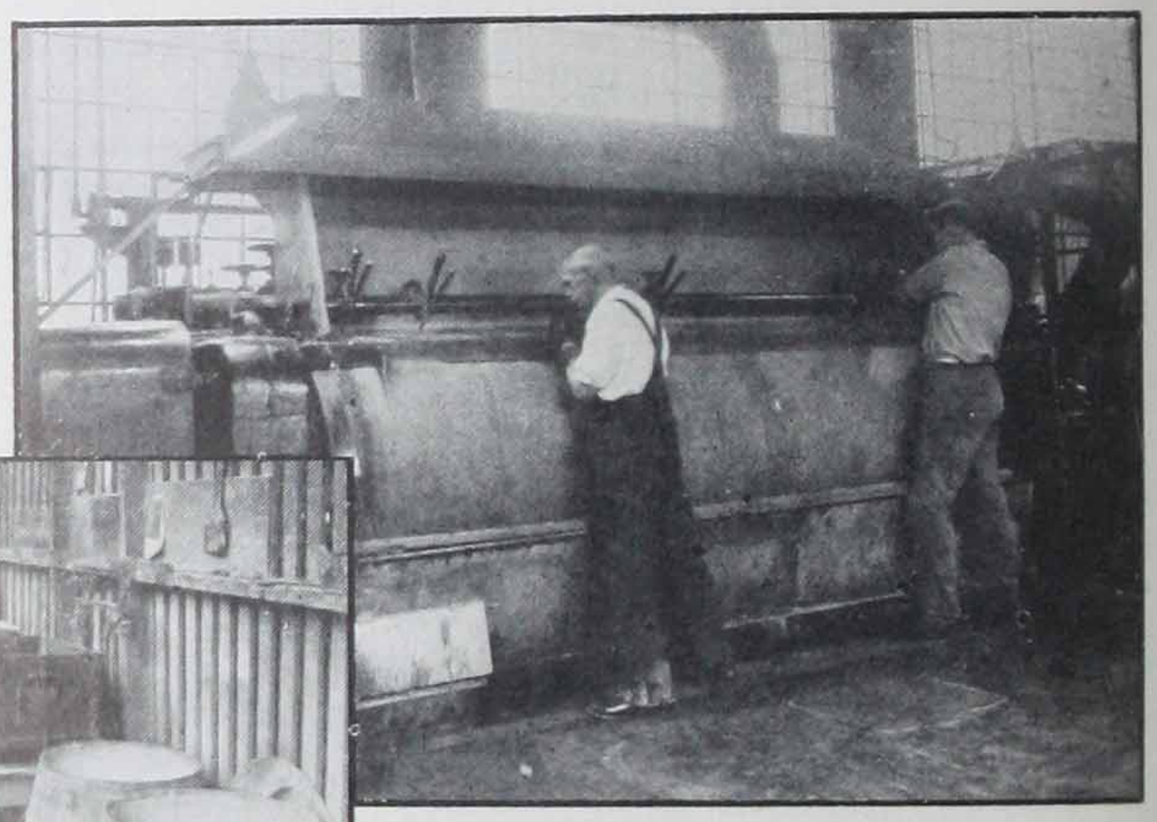
Only a minimum reserve stock of packing need be maintained because of J-M Distributor Service which is operated in conjunction with the J-M Plan. The J-M Distributor receives a copy of the packing application chart and immediately arranges to stock the exact styles and sizes of packing required. This makes replacements easily available on short notice and reduces the stock which must be carried at the plant.

Of first importance are the right packings for all applications, a minimum number of styles and sizes, and immediate distributor service. These, combined with a simple record method and an efficient system of ordering and replacing, complete the most perfect packing service which has yet been devised.

Over 60 years of manufacturing and field experience are behind every J-M Packing



Laboratory control of all materials

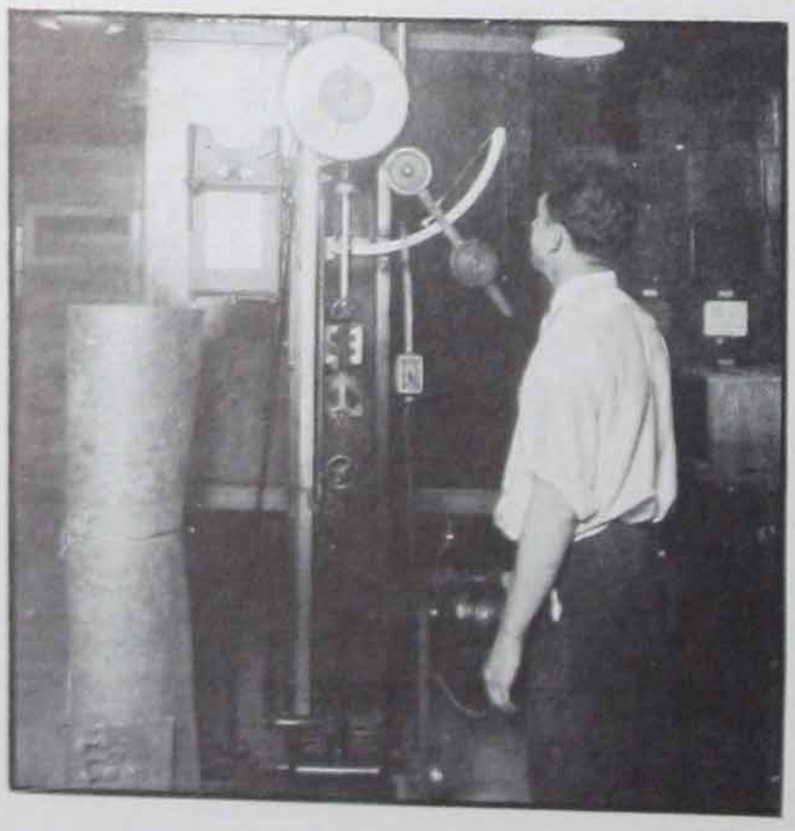


Modern machines and methods

Exactness in compounding

The minimum number of different styles and materials, yet the right packing for any equipment and every service

Meticulous care in testing



Security on old or new equipment, resulting from definite recommendations and closely controlled packing standards

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Johns-Manville Packing Recommendations

Johns-Manville Packings have been developed to meet, with dependability and economy, all types of industrial packing service.

Among the J-M Packings which have become standard through their widespread use are Sea Rings, an automatic packing for reciprocating rods, with a record for durability under severe service, Kearsarge for steam, Flexible Metallic for a more resilient metallic packing, Centripac for centrifugals, Mogul for small packing space and valve stems, Service Sheet for any flange, J-M Flax for hydraulic equipment. Every packing requirement is met by some J-M Packing designed for that purpose.

Coupled with the mechanical excellence of the packing is the service afforded by over 400 convenient distribution points.

Recommendations for specific applications of the various J-M Packings are given below.

NOTE: First material listed for each given condition is best recommendation for that service, with the exception of Sea Rings, which are the first recommendation for any service and condition under which they can be used. For special or unusual conditions, consult Johns-Manville.

SEA RING PACKING—The Automatic Packing for reciprocating rods and plunger, ¾" diameter or over, against steam, water, air, gas and oil, where rod is in line, true and not scored, and where the packing space is not less than 5/16" nor more than 1¼".

FLEXIBLE METALLIC PACKING—This packing is not recommended for brass or bronze rods or shafts.

Rod, Outside-Packed Plunger and Valve Stem Packing

SERVICE	*Reciprocating Rods and Plungers* — *Large Packing Space*	*Reciprocating Rods and Plungers* — *Small Packing Space*	*Centrifugal and Oscillating Rods*	*Valve Stems*
Steam Over 500° F. — Fabric	#167 Superheat #5 High Temperature #6 Rajah	#5 High Temperature #6 or #2 Rajah	#5 High Temperature #6 Rajah	#5 High Temperature #2 or #6 Rajah
Steam Over 500° F. — Metallic	#365 Flexible Metallic #368 Flexible Metallic	#365 Flexible Metallic #368 Flexible Metallic	#365 Flexible Metallic #368 Flexible Metallic	#365 Flexible Metallic #368 Flexible Metallic
Steam 350° to 500° F. — Fabric	#166 Kearsarge #32 Universal Rod #6 Rajah	#6 or #2 Rajah #223 or #222 Mogul #255 or #257 Interlocked	#7 or #11 Centripac #255 or #257 Interlocked #223 or #222 Mogul #166 Kearsarge (oscillating only)	#2 or #6 Rajah #222 or #223 Mogul #193 Mogul
Steam 350° to 500° F. — Metallic	#360 Flexible Metallic #350 Flexible Metallic	#350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic
Steam Under 350° F. — Fabric	#166 Kearsarge #32 Universal Rod #6 Rajah #10 Jewett #223 Mogul #255 Interlocked #271 Cross Diagonal #171 Duro	#223 or #222 Mogul #255 or #257 Interlocked #6 or #2 Rajah #10 Jewett	#7 or #11 Centripac #255 or #257 Interlocked #223 or #222 Mogul #10 Jewett #166 Kearsarge (oscillating only)	#222 or #223 Mogul #2 or #6 Rajah #10 Jewett #193 Mogul
Steam Under 350° F. — Metallic	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic
Water-Hot — Fabric	#271 Cross Diagonal #32 Universal Rod #10 Jewett Combinations of above	#6 or #2 Rajah #10 Jewett #223 or #222 Mogul #255 or #257 Interlocked	#7 or #11 Centripac #255 or #257 Interlocked #223 or #222 Mogul #10 Jewett	#222 or #223 Mogul #10 Jewett #193 Mogul
Water-Hot — Metallic	#360 Flexible Metallic #360 & #362 Flexible Metallic Combination #350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic #360 & #362 Flexible Metallic Combination #350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic

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Recommendations for the use of Johns-Manville Packings—*continued*

SERVICE	*Rod, Outside-Packed Plunger and Valve Stem Packing*			
	Reciprocating Rods and Plungers		*Centrifugal and Oscillating Rods*	*Valve Stems*
	Large Packing Space	*Small Packing Space*		
Water—Cold Over 500-lb. pressure				
Fabric	#188 or #240 Flax #188 or #240 Flax, with end rings of #33 Universal or #182 Aqua	#188 or #240 Flax #188 or #240 Flax, with end rings of #33 Universal or #182 Aqua; #10 Jewett	#11 Centripac #257 Interlocked #10 Jewett #188 or #240 Flax	#10 Jewett #223 Mogul
Metallic	#360 Flexible Metallic #363 Flexible Metallic #360 & #363 Combination	#360 Flexible Metallic #363 Flexible Metallic #360 & #363 Combination	#360 Flexible Metallic #350 Flexible Metallic #363 Flexible Metallic #360 & #363 Combination	#360 Flexible Metallic #350 Flexible Metallic
Water—Cold 100 to 500-lb. pressure				
Fabric	#188 or #189 Flax #32 Universal Rod #10 Jewett	#188 or #189 Flax #10 Jewett #223 or #222 Mogul #255 or #257 Interlocked	#7 or #11 Centripac #255 Interlocked #223 or #222 Mogul	#222 or #223 Mogul #10 Jewett
Metallic	#360 Flexible Metallic #363 Flexible Metallic #360 & #363 Combination	#360 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic
Water—Cold Fresh or Salt Under 100-lb. pressure				
Fabric	#189 Flax #2000 Flax #32 Universal Rod	#223 or #222 Mogul #255 or #257 Interlocked #189 Flax #2000 Flax	#7 Centripac #255 Interlocked #223 or #222 Mogul	#222 or #223 Mogul #193 Mogul
Metallic	#360 Flexible Metallic #363 Flexible Metallic #360 & #363 Combination	#360 Flexible Metallic #360 & #363 Combination	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic
Brine				
Fabric	#240 or #181 Flax #188 or #189 Flax	#240 or #181 Flax #188 or #189 Flax	#7 Centripac #255 Interlocked	#222 or #223 Mogul #193 Mogul
Metallic	#360 Flexible Metallic #360 & #363 Combination	#360 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic	#360 Flexible Metallic #350 Flexible Metallic
Ammonia				
Fabric	#172 Besta-Monia #172-D.C. and #172-S. C. Besta-Monia Combination Rings #271 Cross Diagonal Combination of #172 or #271, with #7 Centripac or #223 Mogul	#172 Besta-Monia #271 Cross Diagonal Combination of #172 or #271, with #7 Centripac or #223 Mogul	#7 Centripac #255 Interlocked #223 or #222 Mogul	#222 or #223 Mogul #193 Mogul
Metallic	#362 Flexible Metallic #360 & #362 Combination	#360 Flexible Metallic	#362 Flexible Metallic #360 & #362 Combination	#360 Flexible Metallic
Air				
N. Y. & Westinghouse Air Pumps	#15-55 Combination Rings #15 Kearsarge #166 Kearsarge	#222 or #223 Mogul #10 Jewett		
Air Compressors or Air Vacuum Pumps	#55 Air Packing #7 Centripac Sea Rings with #789 Thermo (lubricated and graphited) for header and follower rings			
Air Compressors, "two-stage"				
Fabric	Combination of #789 Thermo (lubricated and graphited) and #10 Jewett			
Metallic	#362 Flexible Metallic #360 & #362 Combination	#360 Flexible Metallic		

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Recommendations for the use of Johns-Manville Packings—*continued*

SERVICE	*Rod, Outside-Packed Plunger and Valve Stem Packing*			
	Reciprocating Rods and Plungers		*Centrifugal and Oscillating Rods*	*Valve Stems*
	Large Packing Space	*Small Packing Space*		
Acid—(Strong) *Note: Best resul*	#2017 Acid #2015 Acid #2010 Acid *ls can be secured by advisin*	#2017 Acid #2015 Acid #2010 Acid *g all conditions of service.*	#2018 Acid #2015 Acid #2010 Acid	#2017 Acid #2016 Acid
Acids—(Weak)	#223 Mogul #255 Interlocked #350 Flexible Metallic #360 Flexible Metallic	#223 Mogul #255 Interlocked #350 Flexible Metallic #360 Flexible Metallic	#7 Centripac #255 Interlocked #350 Flexible Metallic #360 Flexible Metallic	#222 or #223 Mogul
Food Products, Alcohol, Caustic, Weak Acids (to prevent discoloration)	#2035 White Lubricated	#2035 White Lubricated	#2036 White Lubricated	#2035 White Lubricated
Caustic (Strong)	#2020 Caustic #2022 Caustic	#2020 Caustic #2022 Caustic	#2021 Caustic #2022 Caustic #350 Flexible Metallic #360 Flexible Metallic	#2021 Caustic #2022 Caustic
Caustic (Weak)	#223 Mogul #255 Interlocked #350 Flexible Metallic #360 Flexible Metallic	#223 Mogul #255 Interlocked #350 Flexible Metallic #360 Flexible Metallic	#7 Centripac #255 Interlocked #350 Flexible Metallic #360 Flexible Metallic	#222 or #223 Mogul
Vegetable Oil	#223 or #222 Mogul #255 or #257 Interlocked, #10 Jewett	#223 or #222 Mogul #255 or #257 Interlocked #10 Jewett	#7 or #11 Centripac #255 or #257 Interlocked #350 Flexible Metallic #223 or #222 Mogul #10 Jewett #360 Flexible Metallic	#222 or #223 Mogul #193 Mogul #10 Jewett
Natural Gas Over 500-lb. pressure	Sea Rings with #789 Thermo (lubricated and graphited) for header and follower rings Combination of #789 Thermo (lubricated and graphited) and #10 Jewett			
Natural Gas Under 500-lb. pressure	#15 Kearsarge #223 Mogul #10 Jewett	#223 or #222 Mogul #10 Jewett		
Crude Oil 350° to 1000° F.	#789 Thermo #871 Hot Oil #731 Hot Oil #6 Rajah #5 High Temperature	#789 Thermo #871 Hot Oil #731 Hot Oil #6 or #2 Rajah #5 High Temperature	#789 Thermo #5 High Temperature #871 Hot Oil #731 Hot Oil	#789 Thermo #2 or #6 Rajah #5 High Temperature #871 Hot Oil #731 Hot Oil
Crude Oil 100° to 350° F.	#10 Jewett #223 Mogul #255 or #257 Interlocked #6 Rajah	#10 Jewett #223 Mogul #255 or #257 Interlocked #6 Rajah	#7 Centripac #255 or #257 Interlocked #350 Flexible Metallic #10 Jewett #223 Mogul #360 Flexible Metallic	#222 or #223 Mogul #10 Jewett
Crude Oil Under 100° F.	#10 Jewett #223 Mogul #255 or #257 Interlocked #188 or #240 Flax	#10 Jewett #223 Mogul #255 or #257 Interlocked #188 or #240 Flax	#7 Centripac #255 or #257 Interlocked #350 Flexible Metallic #10 Jewett #223 Mogul #360 Flexible Metallic	#222 or #223 Mogul #10 Jewett
Gasoline Distillate	#323 or #322 Gasoline Rod #361 Flexible Metalic	#323 or #322 Gasoline Rod	#18 Centripac #351 Flexible Metallic #323 or #322 Gasoline Rod #361 Flexible Metallic	#322 or #323 Gasoline Rod, #293 Gasoline Rod

J-M PACKING RECOMMENDATIONS
November, 1936

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Recommendations for the use of Johns-Manville Packings—*continued*

Rod, Outside-Packed Plunger and Valve Stem Packing

SERVICE	*Reciprocating Rods and Plungers*		*Centrifugal and Oscillating Rods*	*Valve Stems*
	Large Packing Space	*Small Packing Space*		
Fuel and Lubricating Oils	#223 Mogul; #10 Jewett #255 Interlocked #360 Flexible Metallic	#223 Mogul; #10 Jewett #255 Interlocked #360 Flexible Metallic	#223 Mogul #360 Flexible Metallic #350 Flexible Metallic	#223 Mogul #360 Flexible Metallic
Asphaltic and Heavy Oils 350° to 500° F.	#789 Thermo #10 Jewett #11 Centripac #350 Flexible Metallic	#789 Thermo #10 Jewett #11 Centripac #350 Flexible Metallic		
Asphaltic and Heavy Oils Under 350° F.	#10 Jewett #11 Centripac #350 Flexible Metallic	#10 Jewett #11 Centripac #350 Flexible Metallic		

SERVICE	*Inside-Packed Piston Packing*
Hot Water Cold Water Crude Oil Gasoline under 400° F. Mineral Seal Oil	#33 Universal; #295 Light Weight Hydraulic #182 Aqua; #290 Square Hydraulic

SERVICE	*Sheet Packing*
All Conditions	#60 Service
Hot Oils	#70 Asbestos
Cold Oil or Gasoline	#711 Seigelite
Hot Caustic	#70 Asbestos
Low-Pressure Water, Steam, Air	#107 Liberty
	Note: Use #100 Kearsarge or #101 Mobilene for rough or uneven flanges against steam and gas

SERVICE	*Expansion Joints*
All Conditions	See standard Rod and Plunger recommendations

SERVICE	*Gaskets*
All conditions	#60 Service Gaskets
Hot Oil	#70 Asbestos Gaskets
Cold Crude Oil or Gasoline	#711 Seigelite Gaskets
Hot Caustic	#70 Asbestos Gaskets
Boiler handhole or manhole	#116 Kearsarge
Boiler tube plate:	
B. & W., Heine, Edge Moor	#118 Kearsarge Jointless or #116 Kearsarge
All other tube plates	#116 Kearsarge
Emergency manhole or handhole or round cross-section	#124 Kearsarge Tubular Gasketing
Surfaces too uneven or rough for #60 Service	#116 Kearsarge or #100 Kearsarge
Odd or irregular gaskets	#120 Kearsarge Gasketing Tape

SERVICE	*Pump Valves*
Hot Water—Maximum 300-lb. pressure, 300° F.	#424
Cold Water—Pressure up to 200 lb.	#416
Cold Water—200 to 400-lb. pressure	#415
Condenser	#420
Oil, Ammonia, Syrups, etc.—Maximum 300-lb. pressure; 300° F.	#430
Hot or cold oil, gasoline, naphtha, etc., paraffin, hot or cold water, weak acids and weak alkalis. Limit 300° F., all pressures	#300

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Recommendations for the use of Johns-Manville Packings—*continued*

SERVICE	*Oil Field Special Packing Recommendations*
Swivel	#7 Centripac #255 Interlocked with end rings of #33 Universal Combination of #166 Kearsarge and #32 Universal Rod with end rings of #33 Universal Piston for the wash pipe and of #10 Jewett for top and bottom oil #184 Low-Pressure Diagonal Ring
Polish Rod Stuffing-Box	#373 Polish Rod Ring
Slush Pump	Fluid End: #474 Slush Pump Ring #184 Low-Pressure Diagonal Ring #476 Combination Slush Pump Set (Two #474 rings and one #184 ring) Steam End: #166 Kearsarge #156 Oil Field Spiral #271 Cross Diagonal

SERVICE	*Pipe Line Station Special Packing Recommendations*
Reciprocating Pipe Line Pumps	Sea Rings—special for pipe line work #188, #240, #189 Flax or #181 W. P. H. Flax
Centrifugal Pipe Line Pumps Cooling Pumps Suction Pumps	#7 Centripac; #255 Interlocked; #350 or #360 Flexible Metallic #271 Cross Diagonal #295 Light Weight Hydraulic or #33 Universal

SERVICE	*Oil Refinery Special Packing Recommendations*
Bubble Towers	#733 or #873 Braided Rope
Scraper Rod	#128 Kearsarge Lute Coil; #90 K.U.; #166 Kearsarge or #731 Hot Oil
Tank Car Dome Gaskets	#116 Kearsarge or #60 Service
Tank Car Outlet Cap Gaskets	#60 Service or #711 Seigelite (wax-dipped)
Fire, Steam or Pressure Stills	#60 Service or #219 Felted Asbestos
Filterhead (percolating filters)	#787 Braided Asbestos Rope

SERVICE	*Steel Mill Special Packing Recommendations*
Hot Blast Stove cleanout doors, Boiler explosion doors, etc.	#790 Groove Packing
Converter bottoms	#177 Groove Packing
Butterfly valves	#872 Groove Packing
Benzol, Tar, Wash Oil, Ammonia Liquor	Sea Rings
Service Water (Sheet packing)	#60 Service or #107 Liberty

SERVICE	*Lumber Special Packing Recommendations*
Shot Guns Feed Engines Kickers Niggers Donkey Engines Log Turners Loaders	Top and bottom rings of #280 Braided Copper together with #15 Kearsarge, #32 Universal or #271 Cross Diagonal; or combinations of #15, #32, or #271

SERVICE	*Miscellaneous Special Packing Recommendations*
Steam Hammers Accumulators	Rods: #32 Universal; #271 Cross Diagonal; #166 Kearsarge; #90 K.U., or combinations of #32, #271, #166 and #90. Plungers: #33 Universal and #240 W. P. H. Flax or top and bottom rings of #33 Universal with #240 W. P. H. Flax between or alternate rings of #90 K.U. with #240 W. P. H. Flax between
Milk Homogenizers and Viscolizers	Sea Rings #32 Universal
Food Products	#2035 or #2036 White Lubricated
Oxygen	#873 Pure Braided Asbestos Rope
Ceramic Slip Pumps and Tunnel Kiln Pushers	Sea Rings

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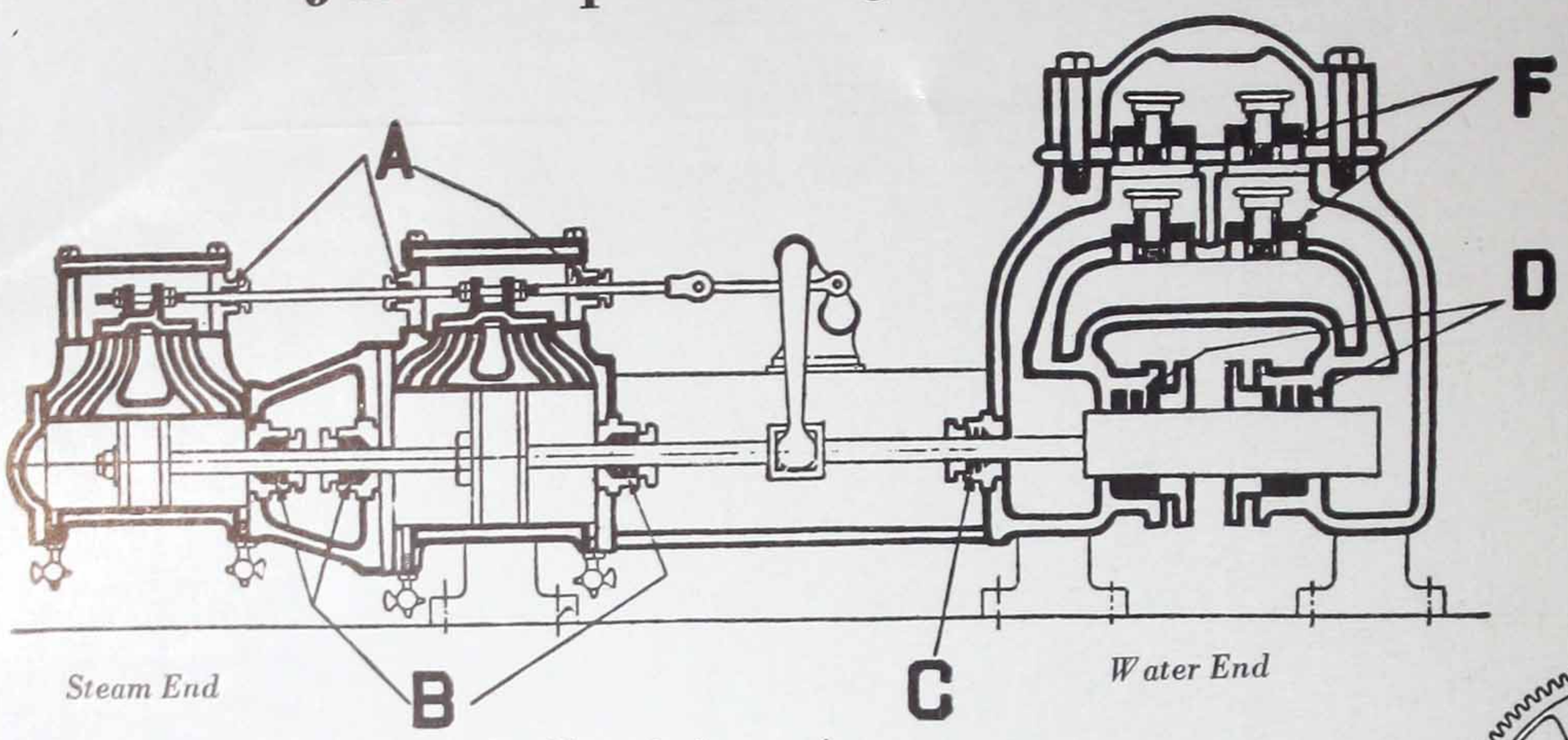
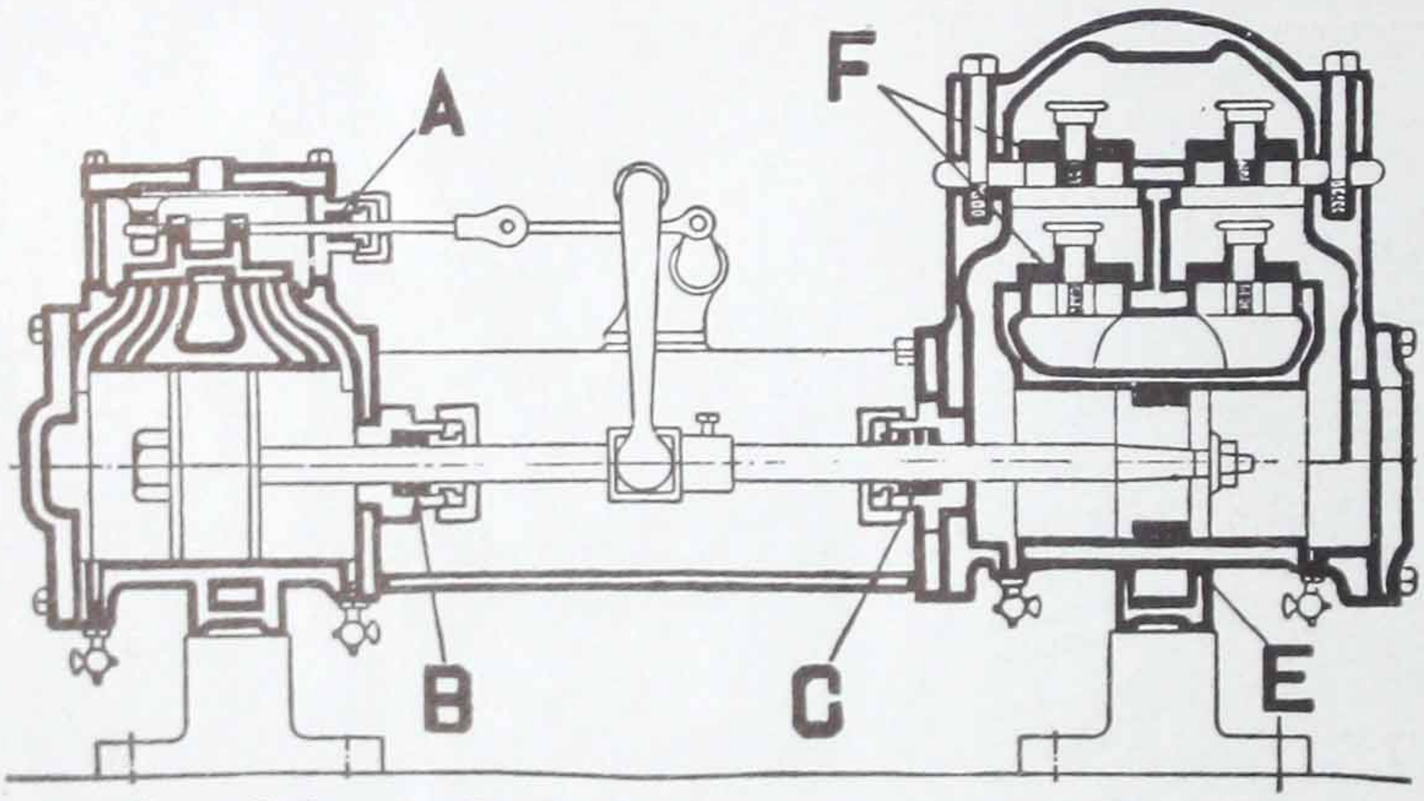
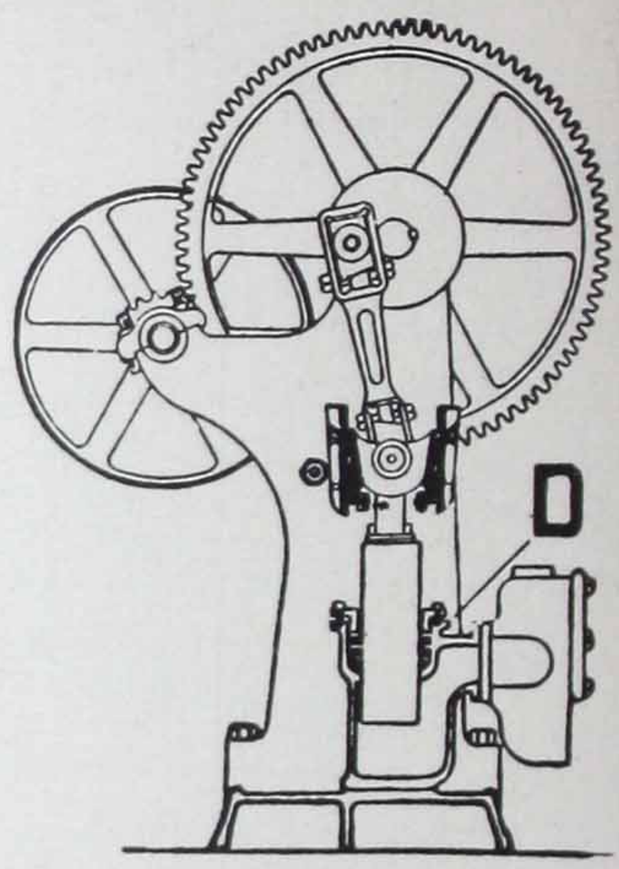
J-M Pump Packing Recommendations



Outside-packed type of pump



Inside-packed type of pump



Vertical outside-packed type of pump

For best results, pumps should be packed as follows:

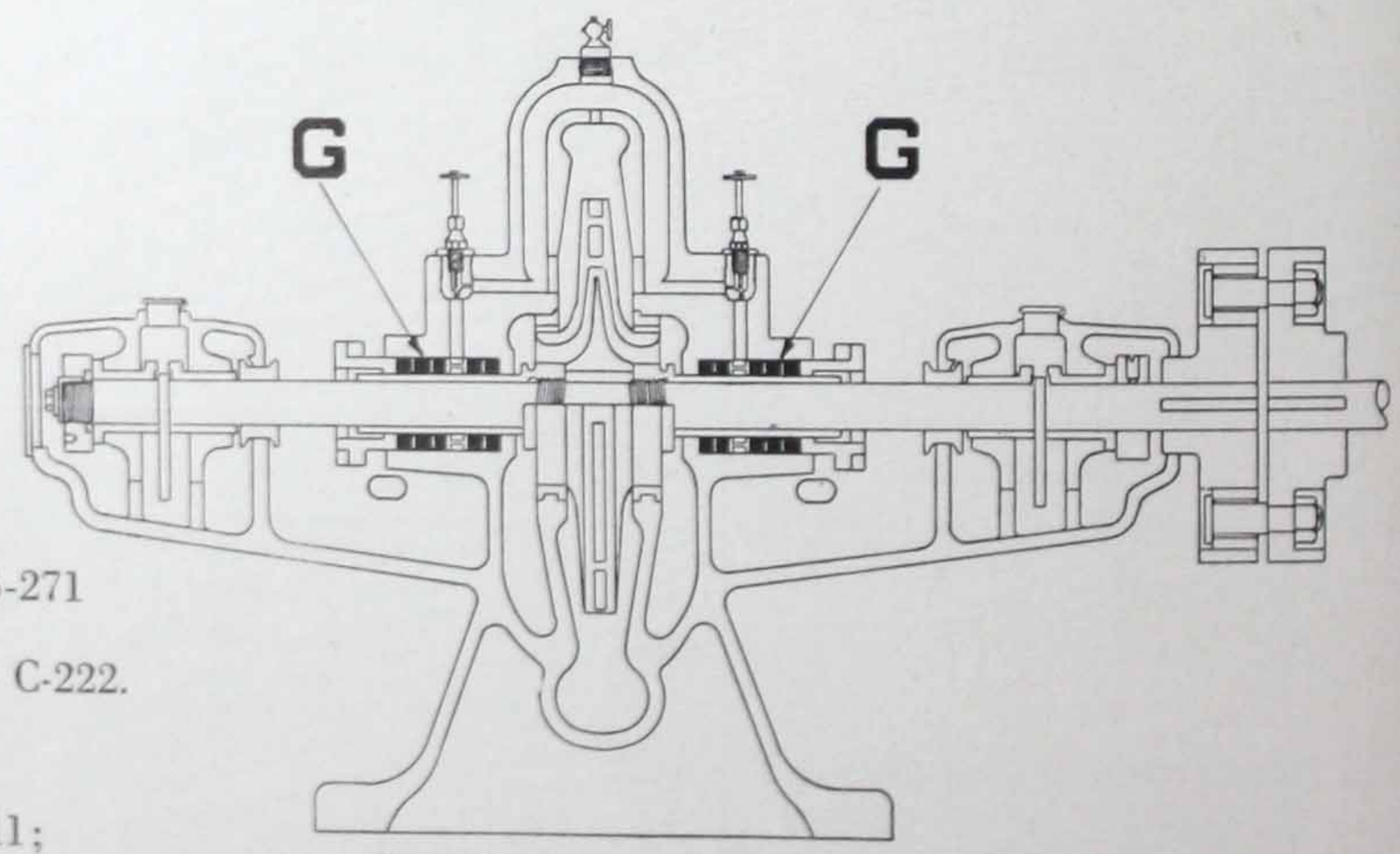
A, B, C, D — Sea Rings, except where rod or plunger is under ¾″ diameter, or space between rod and stuffing-box is less than 5/16″, in which case use Mogul, No. C-222 or No. C-223.

or

A, B — Kearsarge, No. S-166.

C—Hot water: Cross Diagonal, No. S-271
D—Cold water: J-M Flax, No. 189
For small packing space, Mogul, No. C-222.

E—Universal Piston, No. S-33
F—J-M Pump Valves
G—Centripac, No. C-7 or No. C-11;
Interlocked No. C-255 or No. C-257;
No. 350 Flexible Metallic;
No. 360 Flexible Metallic.



Centrifugal type of pump

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How to get the best results from packings

Rod Packings

Packing results will depend mainly on four factors:

1. **Quality of Packing Used.** Johns-Manville's manufacturing and field experience, laboratory control and responsibility assure you of quality.

2. **The Right Style of Packing for the Condition.** The table of J-M packing recommendations given on other pages is based on field experience. If you have a special condition not covered, consult Johns-Manville.

3. **Proper Installation and Working-in.** Use the correct size of packing and cut the rings to the proper size for the conditions. On cold conditions, such as cold water and brine, cut the rings to exact size, as there is little expansion. A slight clearance on the ends of the rings for steam service and more clearance for hot conditions, such as hot water and ammonia, may be advisable. Realize also that there will be greater expansion on rings of large diameter.

Remove all old packing and see that the stuffing-box is clean.

Seat each ring in the box as it is applied.

Apply plenty of lubrication, such as lubricating oil or grease and graphite, when installing packing, to help the packing work in.

Stagger or break the joints. When the necessary number of rings have been installed, take up evenly on the gland with a wrench, to assure that the packing is seated, then slacken off and take up only finger tight.

It is often advisable to allow the box to leak slightly in the beginning, to allow for expansion and proper seating. Packing that is too tight in the box will cause undue friction and wear out quicker. A little extra care in the beginning will be well repaid in longer life and less frequent re-packing.

Especially watch packing on hot water pumps and ammonia compressors. Against hot water it may be necessary, due to expansion, to slack off on the gland from time to time until a balance is reached. On ammonia compressors, during the "heat" period, it is often necessary to slack off on the gland when it has been taken up tight on the "freeze".

Be sure that the gland is not cocked, but that it is even, and exerting equal pressure all around. Continued lubrication is essential. It cuts down friction and prevents undue wear of packing or scoring of rods.

4. **Mechanical Condition of Equipment.** Scored, fluted, eroded, rusty, shouldered or bent rods, or rods running low or out of true, will shorten the life of any packing. Use only high quality rods. They are cheaper in the end. Keep the equipment in good mechanical condition. Use a quality packing that won't harden in service, and keep the rod well lubricated.

Spiral and Coil Packings

Spiral and coil packings are preferable to ring packing from the economy and convenience angle. Coil and spiral packings are not only lower in price, but require a much lower packing stock investment than if ring packings of all required sizes are carried on hand. A box of one size of spiral or coil packing will take care of many different stuffing boxes, and can be obtained quickly from your J-M Packing Distributor.

Use of Lubricating Seal Ring

Johns-Manville applies scientific control over the type and quantity of lubrication incorporated in their packings. However, it is impossible to put sufficient lubrication into any packing to last throughout its normal operating life. Lack of lubrication has a tendency to increase friction and to make all packing lose its resiliency and become harsh. The use of a Lubricating Seal Ring has proved effective in materially increasing the life of packings. Lubricating Seal Rings are especially effective when used on rotating shafts for all conditions.

The Seal Ring, a suggested design for which is here shown, can be either turned from solid stock or

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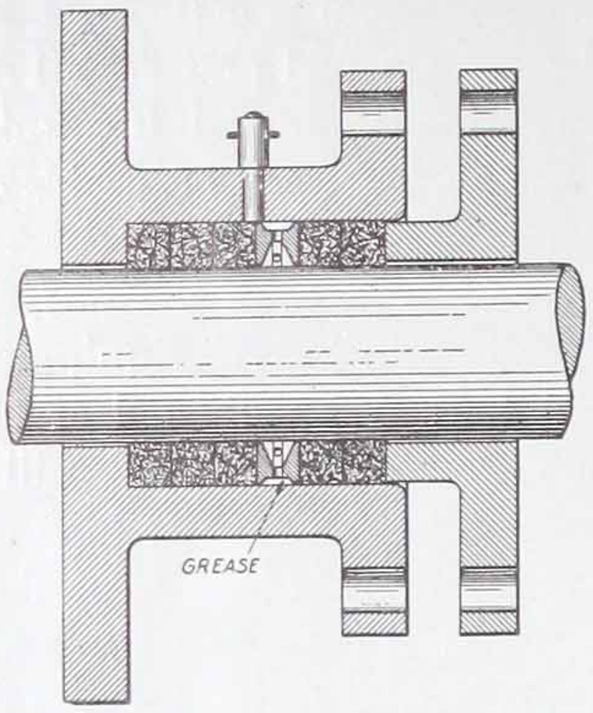
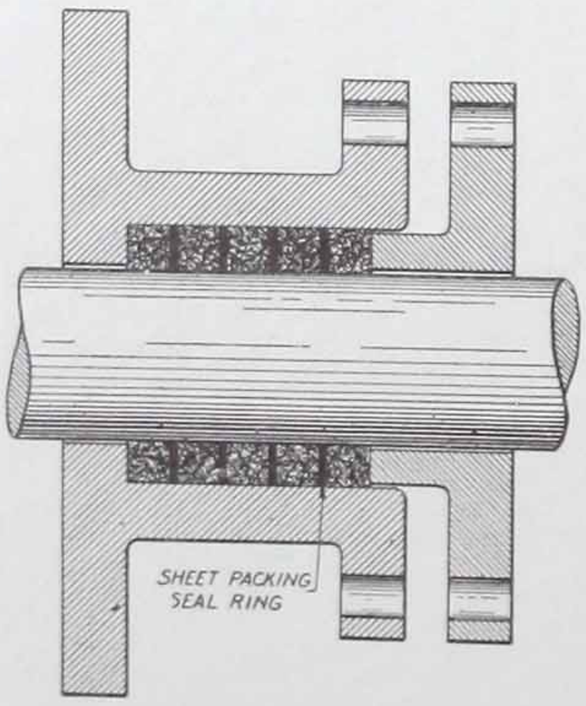
made from sand castings. In turning the Seal Ring, care should be taken to make the ring a close fit to the inside diameter of the stuffing-box, leaving a positive clearance on the rod so as to allow the lubricant to work through the packing and along the rod. Standard grease and oil fittings can be used for introducing the lubricant into the Seal Ring. It is important that



the lubricating hole be so located that the Seal Ring will still remain in contact with it as the packing is taken up.

Use of Sheet Packing Seal Ring

In some cases, Seal Rings cut from Sheet Packing assist in effecting a gradual breaking down of the pressure in the stuffing-box, and are also effective as wipers for removing from the surface of the rod or plunger any oil that tends to adhere as the rod or plunger moves out of the stuffing-box.



The above assembly drawing shows a suggested arrangement of the Sheet Packing Seal Rings.

Gaskets

For Satisfactory Gasket Service:

1. See that the flanges are perfectly clean and true.
2. Use as thin a gasket as possible for the particular flange condition.
3. A ring cut gasket is generally preferable to a full flange gasket.
4. See that the gasket does not project inside the flanges.
5. See that all bolts or studs are in good condition.
6. See that the flanges are pulled up evenly and tightly. Alternate from side to side in taking up bolts or studs to insure even pressure on all parts of the gasket.
7. Use a quality gasket, for the cost of the gasket is only a small part of the total cost.

Boiler Manhole and Handhole Gaskets should be a tight fit on the plates. When it is desirable to graphite the surface of the gaskets, use a solution of graphite, water and a small amount of glycerine. Do not use mineral oil on the gaskets, as it has a tendency to soften the compound in the gaskets and cause failure.

J-M Packing Symbols

For simplification, Johns-Manville uses but one style number for each different kind of packing, instead of a different number for coil, spiral and ring. The following symbols are used to identify the different forms in which J-M Packings are furnished:

Prefix C— = Coil form
S— = Spiral form
R— = Ring form

Suffix—SC = Sectional cut rings
—DC = Diagonal cut rings
—RH = Rock hard
—S = Solid rings (R-182, R-295 and R-290 furnished with step joint unless —S specified)
—C = Rings formed from coil (R-171, R-172, R-182, R-290 and R-295 furnished cut from slab unless —C specified)
—DD = Double dipped in lubrication, or more lubrication than standard
—X = Stitched

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Furnace Expansion Joints

The major types of expansion joints used in various types of boilers and furnaces as a means of preventing failure of structures are shown in Figs. 1 and 2. These are applicable, in a general way, to almost all boiler and furnace walls. Expansion joints not shown on these drawings and found in practice lend themselves to the same manner of packing as those of the same class, illustrated. The location of expansion joints and the class of boiler settings in which they are found are as follows:

Water-tube Boilers
Stirling, Heine, Casey Hedges, Connelly, Badenhausen, Kidwell, Ladd, Erie City, etc.

Location of Expansion Joint	*Drawing References*
1. Furnace roof and side walls	Fig. 1, Detail A
2. Rear wall and side wall	Fig. 1, Detail H
3. Side walls (vertical joints)	Fig. 1, Detail C
4. Side and end wall	Fig. 1, Detail B
5. Relieving arch	Fig. 1, Detail G
6. Bridge wall	Fig. 2
7. Combustion arch, side and end walls	Fig. 2
8. Steam drum and brick setting	Fig. 2

B & W, Springfield, Edge Moor, Wickes, Erie City, Walsh and Weidner, etc.

1. Furnace roof and side walls	Fig. 1, Detail A
2. Rear wall and side walls	Fig. 1, Detail H
3. Side walls (vertical joints)	Fig. 1, Detail C
4. Side and end wall	Fig. 1, Detail B
5. Relieving arch	Fig. 1, Detail G
6. Water-tube header	Fig. 1, Detail E
7. Front water-tube header and setting	Fig. 1, Detail D
8. Rear water-tube header and setting	Fig. 1, Detail F
9. Bridge wall	Fig. 2
10. Combustion arch, side and end walls	Fig. 2
11. Steam drum and brick setting	Fig. 2

Fire-tube Boilers

1. Boiler shell and brick settings	Fig. 2
2. Side walls (vertical joints)	Fig. 1, Detail C
3. Union of side and end walls	Fig. 1, Detail B
4. Combustion or deflection arch and side walls	Fig. 2
5. Deflection arch and end walls	Fig. 2
6. Bridge wall	Fig. 2

All expansion joints in the boiler setting proper or between parts of the boiler and setting should be so made that the joint is twice as great as the maximum amount of expansion taking place between the adjacent expanding members.

Expansion joint materials are installed while the wall is being constructed, except where joints are accessible and can be conveniently packed after the wall is complete. All material is firmly packed into the joint so that there are no voids.

Where movement of the expanding members is likely to work the packing out of the joint, the expansion joint material is held in place by a spring steel plate or by other suitable means.

Expansion Joint Materials

All expansion joints in the boiler setting proper or between parts of the boiler and the setting are packed with either J-M No. 4200 Asbestos Rope or J-M Asbestos Jelly-Rolls. The size of the expansion joint is the determining factor in choosing between the No. 4200 Asbestos Rope and Jelly-Rolls. J-M No. 4200 Asbestos Rope is used for joints up to 1″ in width. When larger diameter packing is required, standard Asbestos Jelly-Rolls should be used.

J-M No. 4200 Asbestos Rope is made in sizes from ⅜″ to 1″, increasing by increments of ⅛″, but can be furnished when necessary as large as 2″. J-M Asbestos Jelly-Rolls are made of Asbestos Roll Fire-Felt in standard sizes of 1″, 1¼″, 1½″, 1¾″, 2″, 2½″, 3″, 3½″, 4″, 4½″, 5″, 5½″, and 6″ in diameter, in lengths of 3 ft. However, lengths up to six feet are often furnished. Diameters 4″ and greater are rolled around a core of J-M No. 4200 Asbestos Rope.

In expansion joints such as Details D and F, Fig. 1, and the boiler drum-setting expansion joint shown in Fig. 2, the Asbestos Jelly-Rolls are packed in J-M RX Asbestos Fibre. This weighs about 12½ lb. per cu. ft., and is packed in bags weighing approximately 12½ lb. It is used to fill the interstices between the Jelly-Rolls with a resilent material.

The water-tube headers, as shown in Fig. 1, Detail E, can be advantageously packed with strips of J-M Asbestos Roll Fire-Felt. This is furnished in thicknesses of 3/32″, ⅛″, 3/16″ and ¼″, in rolls 3-ft. wide containing approximately 100 sq. ft.

Wall expansion joints should have the openings facing into the combustion chamber sealed with J-M No. 352 Asbestos Cement after the packing is in place. If there is no J-M No. 352 Cement on the job, either J-M No. 302 or No. 400 Asbestos Cement can be used satisfactorily. Asbestos Cement is supplied in 100-lb. bags. The density of No. 352, applied and dried, is about 63 lb. per cu. ft.

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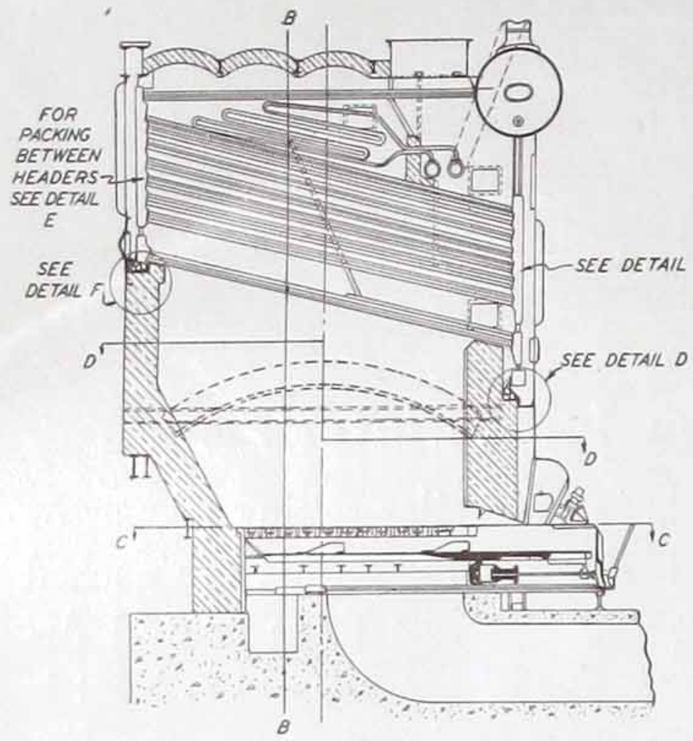
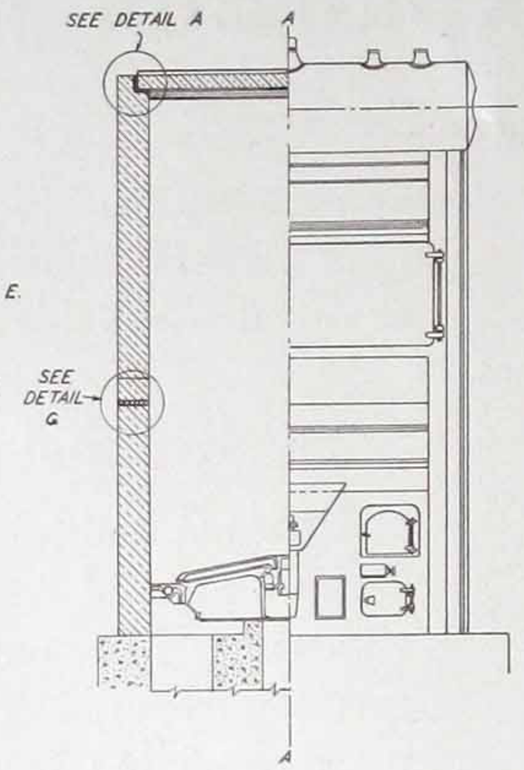
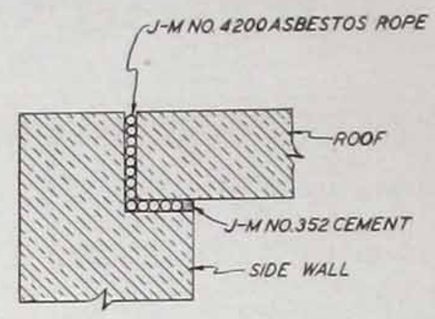


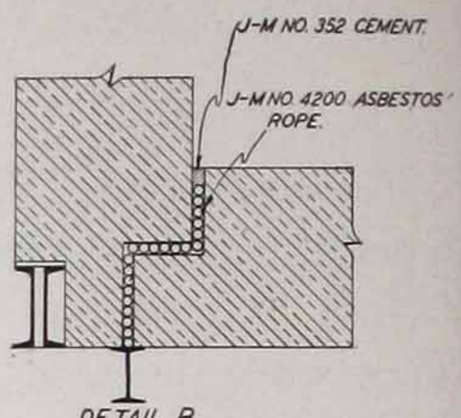
SECTION A-A.



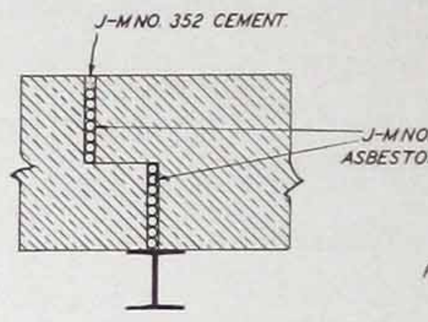
SECTION B-B. FRONT ELEVATION



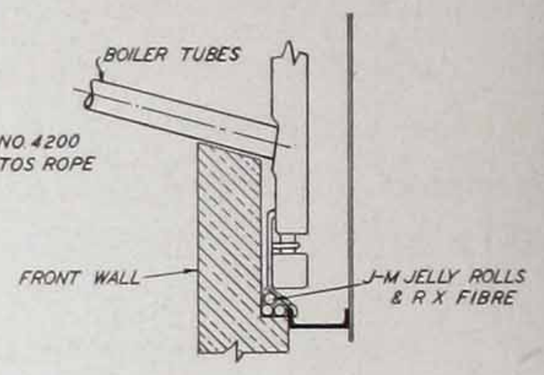
DETAIL A
SHOWING PACKING IN EXPANSION JOINT BETWEEN ROOF & SIDE WALL.



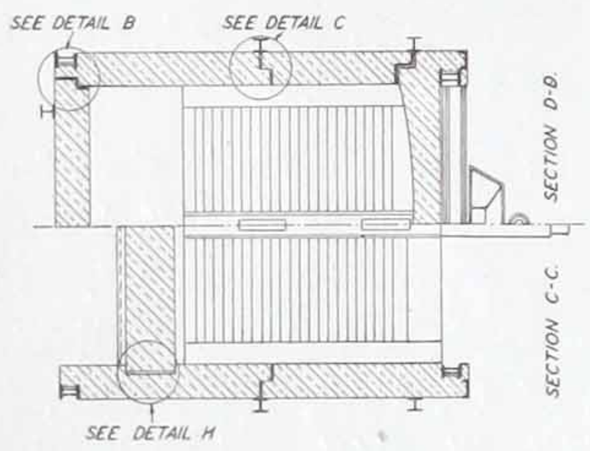
DETAIL B
SHOWING PACKING IN VERTICAL EXPANSION JOINT AT CORNER WALLS.



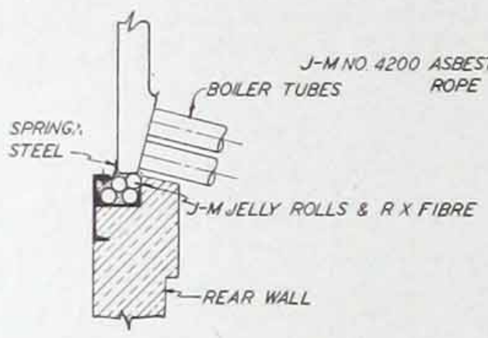
DETAIL C
SHOWING PACKING IN VERTICAL EXPANSION JOINT IN SIDE WALL



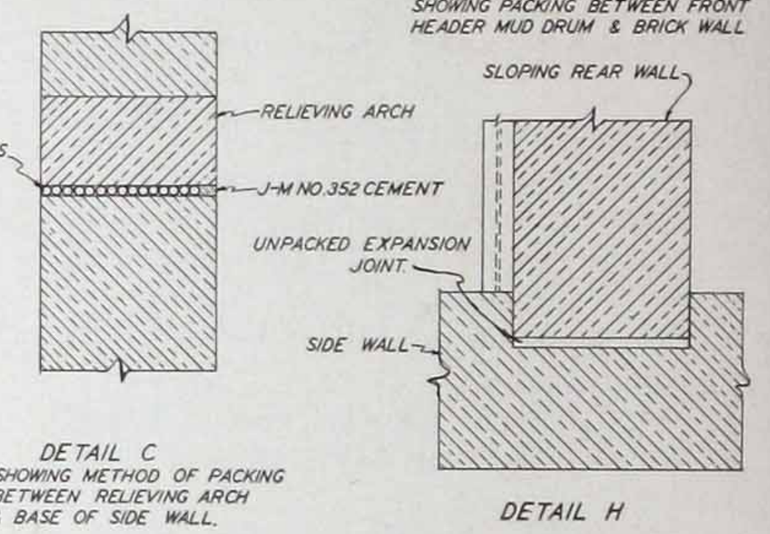
DETAIL D
SHOWING PACKING BETWEEN FRONT HEADER MUD DRUM & BRICK WALL



DETAIL E
SHOWING PACKING BETWEEN WATER TUBE HEADERS.



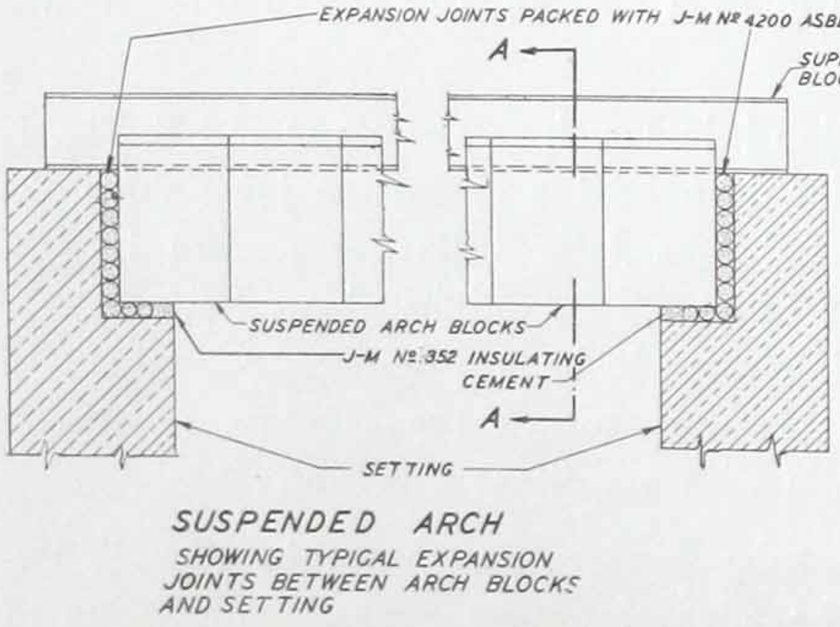
DETAIL F
SHOWING PACKING BETWEEN REAR WATER TUBE HEADERS & REAR WALL.



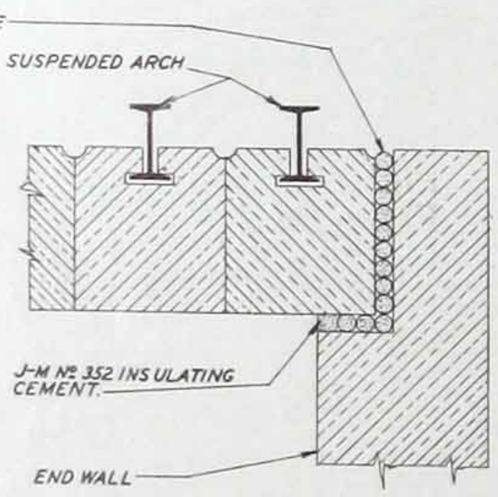
DETAIL C
SHOWING METHOD OF PACKING BETWEEN RELIEVING ARCH & BASE OF SIDE WALL.

DETAIL H

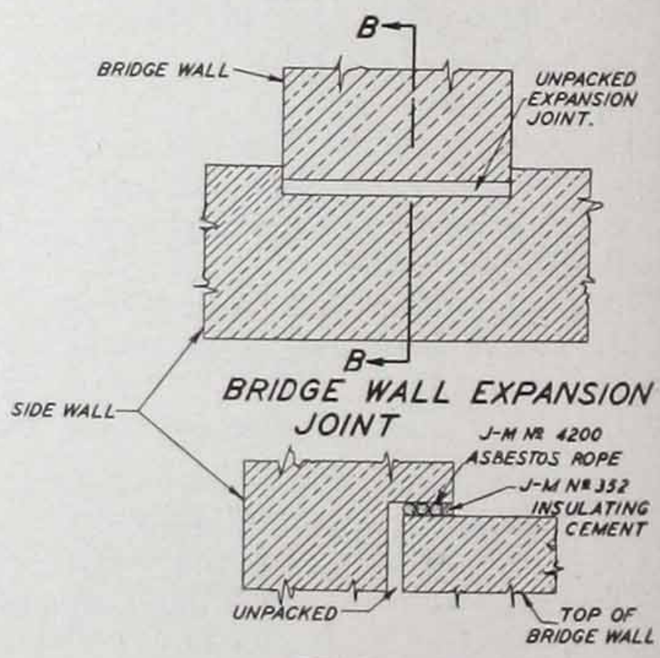
Fig. 1. Boiler Wall Expansion Joint locations and details



SUSPENDED ARCH
SHOWING TYPICAL EXPANSION JOINTS BETWEEN ARCH BLOCKS AND SETTING

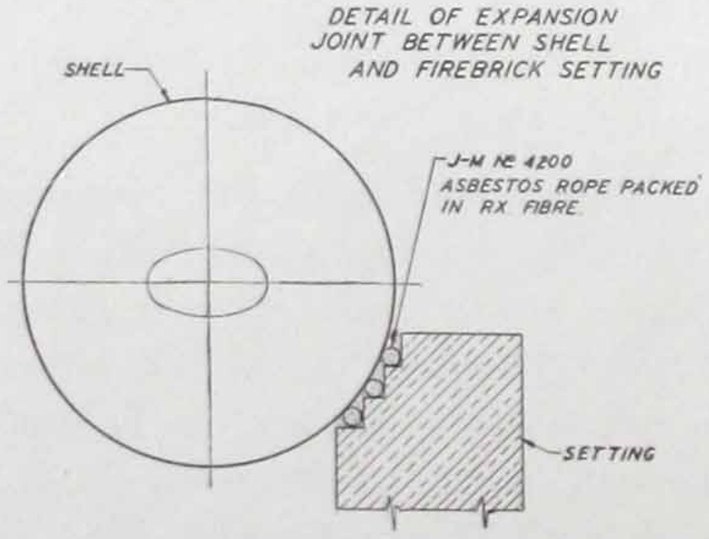


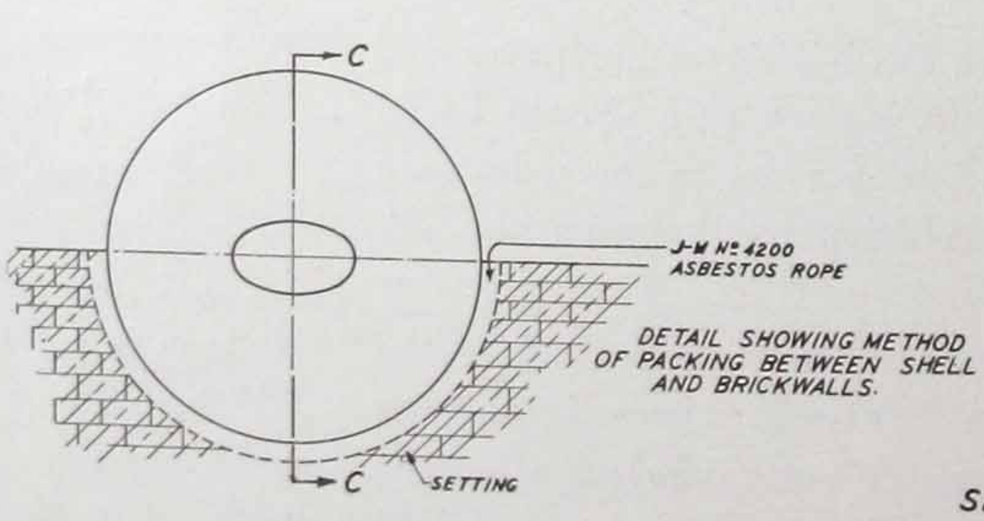
SECTION AA

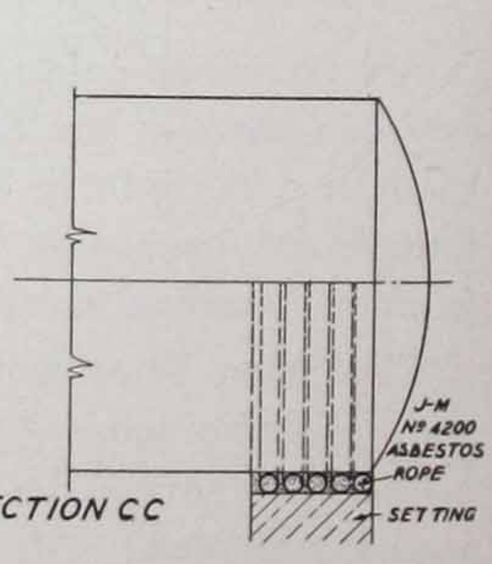


BRIDGE WALL EXPANSION JOINT

SECTION BB







SECTION CC

Fig. 2. Expansion Joints at Suspended Arch, Bridge Wall and Steam Drum

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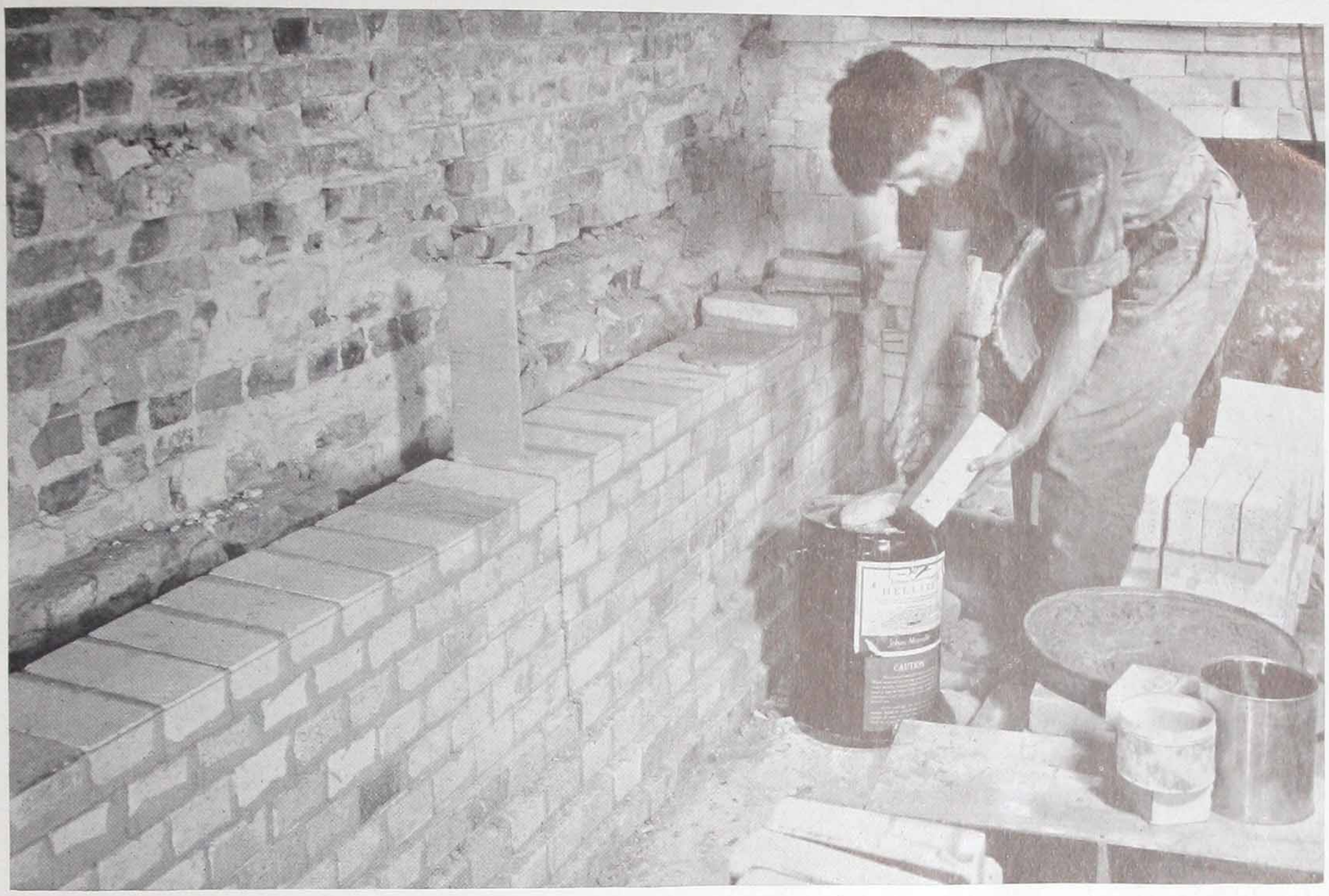
J-M Refractory Products



Scientifically compounded to meet a wide variety of service conditions, J-M Refractories provide a definite means of improving refractory performance

Many different refractory products are necessary to fulfill the diversity of present-day furnace requirements. Johns-Manville meets these needs with cements, castables, plastics and ramming mixtures. These products, used alone or in combination, assure economies through longer life and reduced maintenance.

Cements Prevent Premature Failure

In best furnace practice, J-M Cements are used to bond and protect the fire brick. They increase the life of a refractory structure by resisting temperature, disintegration and spalling under furnace conditions.

The bonding strength and other properties of J-M Refractories are such that the cements will not separate from the fire brick because of movement in the setting. J-M Cements do not break the bond by shrinking or swelling or by reaction with furnace ash, slags or gases.

Exposing the edges of brick to the action of flame and molten ash is the commonest cause of rapid deterioration. Use of the proper J-M Cement cuts down heat losses because open joints and cracks in the setting are eliminated. Well-bonded joints also protect insulation from the action of furnace gases and vapors. Likewise, a tight setting prevents unnecessary cold air from being drawn in through the walls where negative pressures are carried in the furnace.

Fire brick generally soften at a temperature of at least 500 deg. F. below their melting point. When a fire clay or inferior refractory cement is used, open joints or cracks in the setting hasten this action. However, brickwork well-protected with J-M Refractory Cement will stand higher temperatures because the destructive heat has access only to one face of the brick. With heat contacting only a single surface, there is more even temperature gradient throughout the brick. This eliminates internal strain, thereby reducing the spalling caused by sudden temperature changes.

Laying Brick with J-M Refractory Cement:

For general conditions, where the refractory contacts flame or heat but not molten metals, Johns-Manville has found certain types of cement especially suitable for laying brick with either of the two types of joints.

REFRACTORY PRODUCTS
November, 1938 (Cancelling RE–1 and 5 dated in 1938 and 1937)

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Around high temperature zones, for a brick-to-brick or dipped joint the following are recommended:

No. 32 Refractory Cement where a dry, heat-setting cement is wanted.

Hellite Refractory Cement (thinned) where a ready-mixed, air-setting cement is preferred.

To form a bond joint, 1/8" to 3/16"-thick for high temperature zones, the following are recommended:

No. 31 Refractory Cement where a dry, heat-setting cement is required.

Hellite (used as furnished) where a ready-mixed, air-setting cement is wanted.

In addition to the above, other cements of a more specialized nature and different characteristics are available for use where required.

Wash-Coating Cuts Operating Costs

Open joints and rough brick texture give clinkers a good hold, and in removing them, bricks are often pulled out unless they are strongly bonded. Clinkering, however, can be retarded by making surfaces as smooth as possible with wash-coating.

The erosive action of oil flame and the slagging of brick by molten ash are mitigated in a setting which has tightly sealed joints and the brick pores filled by a wash-coat. This protection also tends to prevent brick disintegration caused by the action of furnace gases.

For general wash-coating requirements, the following cements are preferred:

Hellite or No. 20 Refractory Cement where a ready-mixed, air-setting wash-coat is desired.

No. 32 Refractory Cement where a dry, heat-setting cement is preferred.

It is recommended that these cements (in thin grout consistency) be thoroughly worked into the brick.

Patching Lengthens Furnace Life

Failure of eroded furnace walls can be retarded by removing the deteriorated sections and patching with the proper J-M Refractory. The following cements will accommodate general industrial requirements:

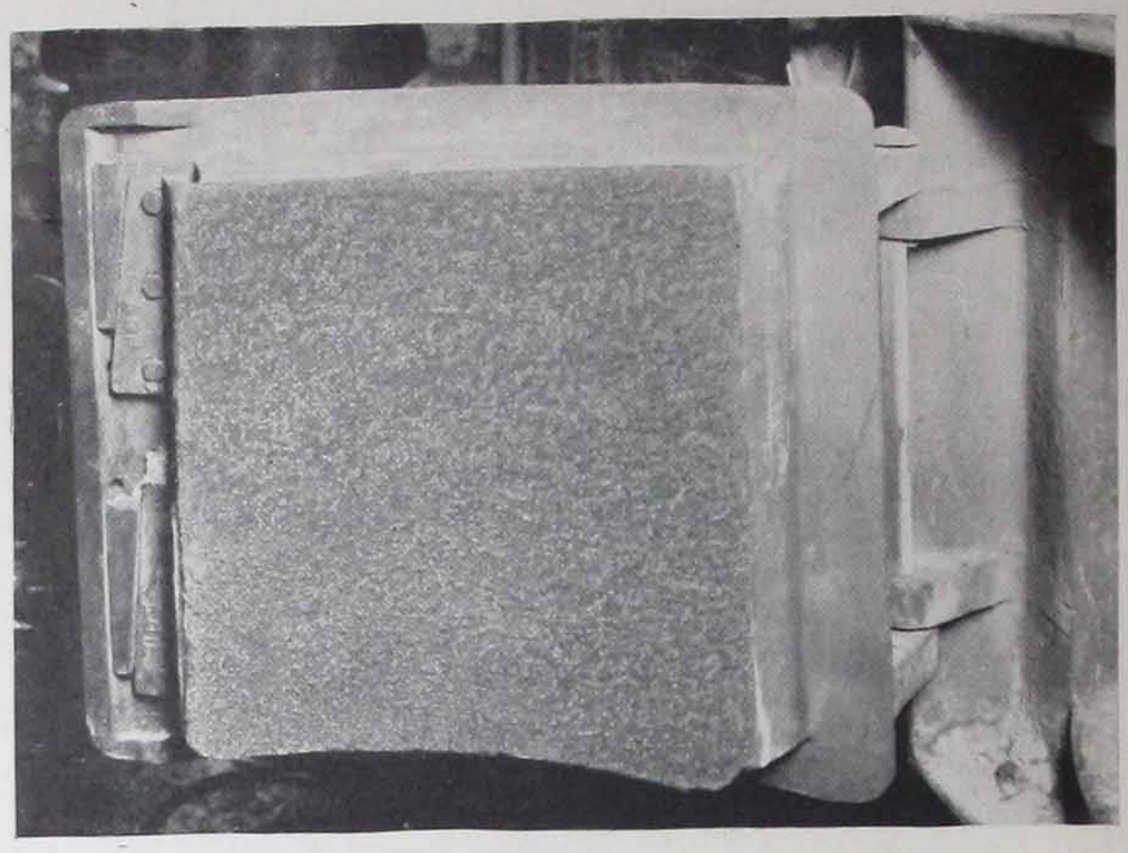
Hellite Refractory Cement for hot or cold shallow patching with trowel or gun.

No. 33 Super Refractory Cement for trowel patching in high temperature zones.

No. 20 Refractory Cement recommended where it is desired to crush and use old fire brick.

Plastic Fire Brick Material for heavy patching where brickwork has spalled or eroded too deeply for troweling.

Methods for applying the above materials appear on the data sheet "Applying J-M Refractory Cements."



Worked like concrete, Firecrete can be cast into linings for boiler inspection doors, quickly and at low cost

Casting Shapes Avoids Delay

Refractory linings and facings of great variety can be efficiently produced with Firecrete cast or, if necessary, rammed in place to form a monolithic construction.

Burner blocks, small monolithic furnaces, combustion chambers for oil burners and stokers, and special refractory shapes also can be quickly and economically cast with Firecrete. Handled like concrete, Firecrete can, in many instances, be used to replace difficult and tedious fire brick construction.

Standard Firecrete, adaptable to a wide range of industrial purposes, is used up to 2400 deg. F.

High Temperature Firecrete, similar in character to standard, is used where the temperature ranges from 2400 to 2800 deg. F.

Light Weight Firecrete, used where a material of light weight, low thermal conductivity and low heat storage is required, has a temperature limit of 2400 deg. F.

Castables reduce the inventory of special shapes because any desired replacement can be made with Firecrete and placed in service within 24 hours.

Technical Control Assures Results

Aided by the most modern testing apparatus, the staff of J-M Ceramic Engineers is continually making comprehensive studies of the physical and chemical properties of refractories. Effort is directed toward developing new J-M Refractories, raising existing standards and determining improved application methods.

A control laboratory, supplementing research, is located at each factory. At these points, raw materials, products in process and finished refractories are tested for uniformity of characteristics and conformance with manufacturing standards.

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Description of J-M Refractory Products

To aid in the selection of the correct J-M Refractory Products, the chief characteristics of each material are summarized on this and the following page. Supplementing this information are data sheets "Recommendations for Refractory Products" which classify under the major industries the J-M Refractories for specific applications. Because this data is compiled from installations where the products are giving excellent service, these recommendations are really those of the refractory users.

Hellite Refractory Cement. A general purpose, air-setting cement which is finely ground, ready-mixed, plastic and pink in color. Used for setting brick with bond or dipped joints, for wash-coating and especially for shallow patching, either hot or cold. Can be used up to 3000 deg. F. It is readily workable, has excellent adherence, minimum drying and firing shrinkage and will not bloat or puff up on rapid heating. Supplied in the proper consistency for use with paddle or trowl, but may be thinned with water for thin mortar joints and for gun or brush coatings.

No. 32 Refractory Cement. A general purpose, heat-setting cement. Supplied dry and finely ground. When mixed with water, it develops excellent workability and will not settle in the mixing box. Used for setting brick with brick-to-brick joints and for wash-coating. Temperature limit 3100 deg. F.

No. 31 Refractory Cement. A heat-setting cement for laying fire brick with a bond or cushion joint, ⅛″ to 3/16″ thick. Similar to No. 32 Cement but with a coarser base. For wash-coating over brickwork which is set up with No. 31, use No. 32. Recommended up to 3100 deg. F.

Standard Firecrete. A dry, hydraulic-setting cement for casting special refractory shapes and for tamping small monolithic linings, etc. Especially advantageous in replacing construction which is difficult or tedious with standard fire brick. Standard Firecrete has no drying or firing shrinkage up to 2400 deg. F. It is used extensively for casting combustion chambers of domestic oil burners and stokers, furnace doors and burner blocks.

H. T. Firecrete. Similar in properties to Standard Firecrete. This high temperature product is recommended for use between 2400 and 2800 deg. F.

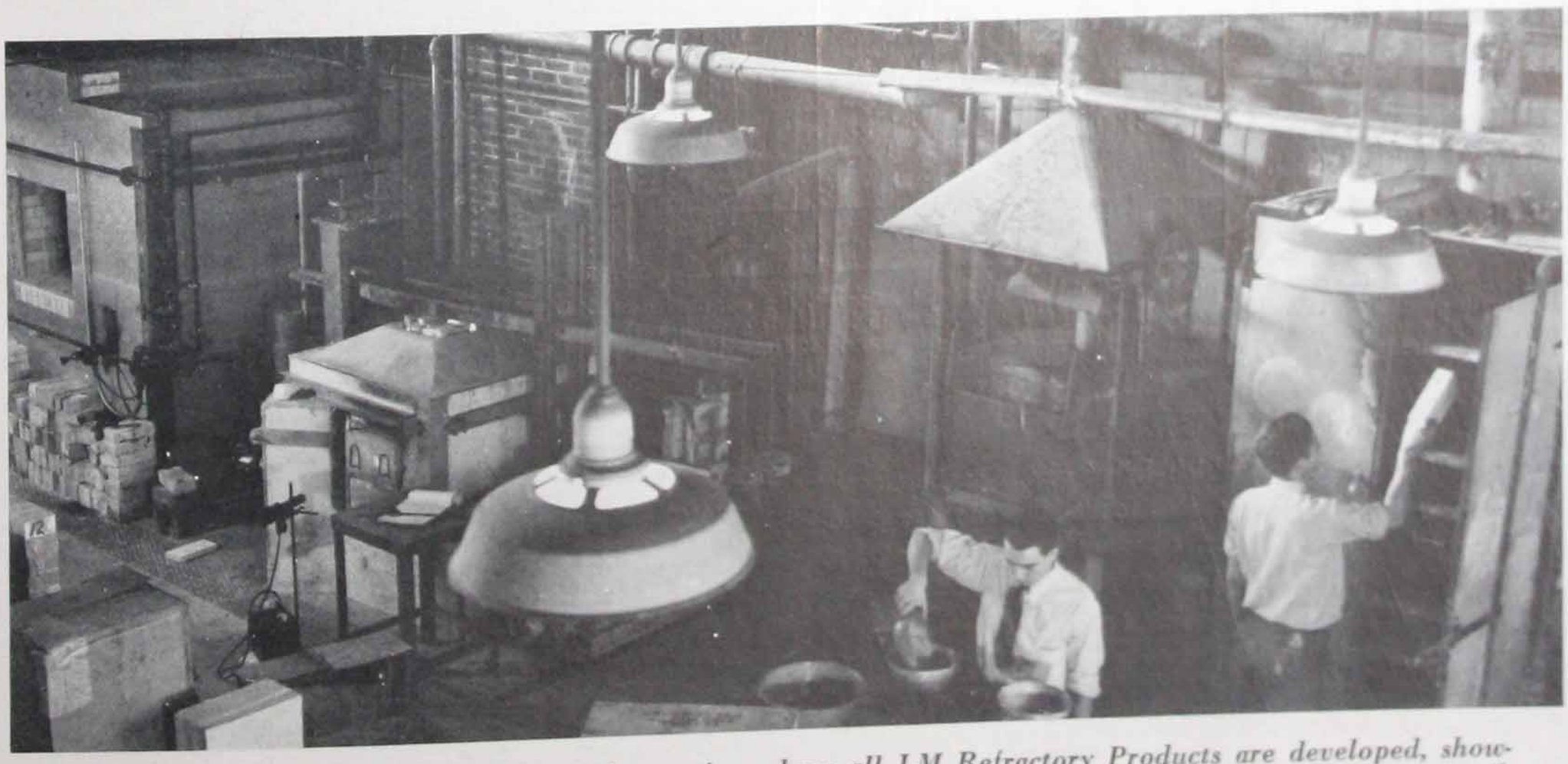
L. W. Firecrete. Similar to Standard Firecrete but much lighter in weight. Has unusually low thermal conductivity and low heat storage capacity. Especially recommended for casting small intermittent furnaces, furnace bottoms or special shapes where these qualities are important. Recommended for temperatures up to 2400 deg. F.

Chrome Castable. A chrome-ore refractory used for lining heating and forging furnace bottoms. This material is particularly resistant to the slagging action of iron scale. Recommended for temperatures up to 3200 deg. F.

No. 20 Refractory Cement. An air-setting cement, gray in color, for use where an extra hard air set is desired. Used up to 2700 deg. F. for setting brick with a rubbed joint, and for wash-coating. When desired to use old fire brick as a patching material or monolithic fill, No. 20 is thinned with water and the crushed fire brick added.

No. 26 Refractory Cement. A coarse, dry cement which takes a medium air set. Used for setting fire brick with a medium bond joint. In special cases also recommended for hot patching, cement gun work and rammed linings. For temperatures up to 2900 deg. F.

No. 30 Refractory Cement. A coarsely milled, dry cement with a silicon carbide base. Used for setting and patching



A small section of the J-M Research Laboratories, where all J-M Refractory Products are developed, showing some of the furnaces used for testing. Lined against the wall, from left to right, are a direct-fired, oil-burning kiln; an A.S.T.M. load-testing furnace; a gas-fired oven furnace and a steam-heated drying oven

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silicon carbide brick. Also applied as monolithic, rammed linings in special oil-fired furnaces. Useful to 3000 deg. F.

No. 33 Super-Refractory Cement. A coarse, dry cement for setting brick with a bond joint and patching in zones where extreme temperatures are encountered. Used in patching Detroit Electric Furnaces. For temperatures up to 3300 deg. F.

No. 34 Refractory Cement. A dry, chrome cement used for monolithic, rammed linings in Ajax Furnaces. Also used for setting brick with a brick-to-brick joint under conditions where a neutral refractory is required. Recommended for temperatures up to 3400 deg. F.

No. 35 Super-Refractory Cement. A dry, high alumina cement, used for special conditions. Useful to 3500 deg. F. for setting brick with a bond joint and for patching.

Plastic Fire Brick Material. A ready-mixed, plastic fire brick, useful to 3100 deg. F. for heavy patching and the replacing of destroyed brickwork. Should be used in a very stiff mix. A wet-rag covering keeps unused material plastic.

The monolithic refractory linings which protect the standpipes in this coke plant were all cast with Firecrete

Data on Johns-Manville Refractory Products

Product	Character or base	Highest working temperature, deg. F.	Lowest working temperature, deg. F.	Pounds needed to set 1000 brick	Pounds needed for 1 cu. ft. of construction	Form in which product is furnished	Method of shipping and net weights
Hellite	al. silicate	3000	air setting	400†		ready mixed	100, 250, 500, 850‡
No. 32	al. silicate	3100	1250	400†		dry	100-lb. bags
No. 31	al. silicate	3100	1450	600*–700*		dry	100-lb. bags
Std. Firecrete	al. silicate	2400	air setting		110	dry	100-lb. bags
H. T. Firecrete	high alumina	2800	air setting		115	dry	100-lb. bags
L. W. Firecrete	high alumina	2400	air setting		75	dry	100-lb. bags
Chrome Castable	chrome ore	3200	air setting		180	dry	100-lb. bags
No. 20	silica	2700	air setting	400†		ready mixed	100, 250, 500, 850‡
No. 26	al. silicate	2900	air setting	600*–700*		dry	100-lb. bags
No. 30	si. carbide	3000	1450	800*		dry	100-lb. bags
No. 33	kaolin	3300	1250	750*	130	dry	100-lb. bags
No. 34	chrome	3400	air setting	600	200	dry	100-lb. bags
No. 35	high alumina	3500	1200	750*	130	dry	100-lb. bags
P. F. B. M.**	al. silicate	3100	1500		133	ready mixed	100, 250, 500¶

* The figure given is for a bond joint, $\frac{1}{8}$"-$\frac{3}{16}$" thick. Without asterisk, the quantities are for brick-to-brick joints. **Plastic Fire Brick Material.
† Approximate quantities required for wash-coating 100 sq. ft.: 35 lb. Hellite with 7 lb. water; 50 lb. No. 32 with 30 lb. water; 40 lb. No. 20 with 7 lb. water. ‡Supplied in drums containing number of pounds indicated. Also furnished in 5, 10, 25 and 50-lb. containers. ¶Supplied in drums containing number of pounds indicated.

Other J-M Products

In addition to refractories which bring about economies in the operation of industrial furnaces, Johns-Manville has products which are used most effectively on furnaces, stoves, hot water heaters and other domestic heating equipment.

Fireite Asbestos Furnace Cement. An odorless, ready-mixed paste for sealing joints of domestic furnaces or boilers. Prevents escape of gas, smoke, soot, and, as it adheres firmly to clean metal, can be used to join broken parts. Withstands highest temperature of domestic equipment. It is preferable to let the cement harden 24 hours before firing and cure under slow fire. Furnished in 1, 2, 3, 5, 10-lb. cans; 25, 50-lb. pails; 100, 250, 500, 850-lb. drums.

J-M Stove Putty. For sealing joints as on hot water heaters and ovens where the putty will not be subjected to intense heat. Especially suitable for hand rolling and running under thumb. Hardens only under heat. Furnished in 1, 2, 5, 10-lb. cans; 35-lb. pails; 65, 375, 675-lb. drums.

DOB Fill. A loose insulating refractory for filling space between the combustion chamber and sides of the furnace. Weight of this material is about 30.5 lb. per cu. ft. DOB (Domestic Oil Burner) Fill is packed in 50-lb. bags.

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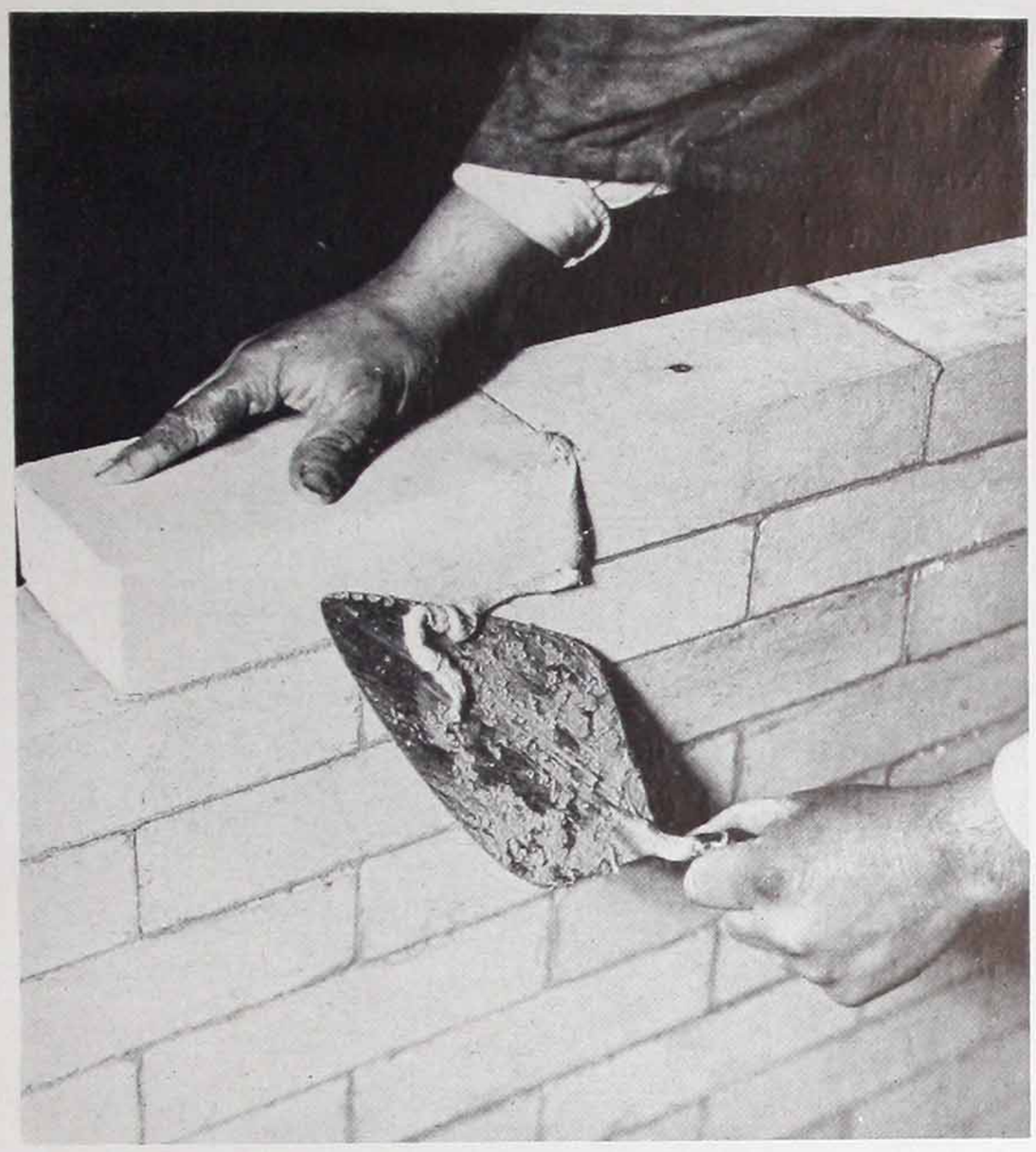
Applying J-M Refractory Cements



Setting fire brick with J-M Refractory Cement insures a tight, strong, well-protected refractory wall

Setting Brick with Bond Joint

Using No. 26, 30, 31, 33, 35 and Hellite:

When preparing J-M Refractory Cements No. 26, 30, 31, 33, 35 and Hellite for use as a bond joint between fire brick, water is mixed with the cement to provide the proper consistency. Clean, fresh water is required, depending in amount upon the porosity of the brick which can best be found by trial. Porous brick require a thinner mixture than those less porous.

A batch of refractory cement mortar may have a good appearance and yet, if a few handfuls of the batch are taken and rubbed together, some cement is found that is dry. The mortar should be thoroughly mixed and free from lumps. It is just as important that an excess of water be avoided.

The cement is "buttered" or troweled on the brick already placed. Then a brick is laid on top and tapped until the joint between the brick is from $\frac{1}{8}''$ to $\frac{3}{16}''$ thick and cement squeezes out between the edges of the brick. The cement is then troweled back over the face of the joint and brick so that it protects the edges of the brick, making a "T" joint.

Setting Brick with Dipped Joint

Using No. 20, 32, 34 and Hellite:

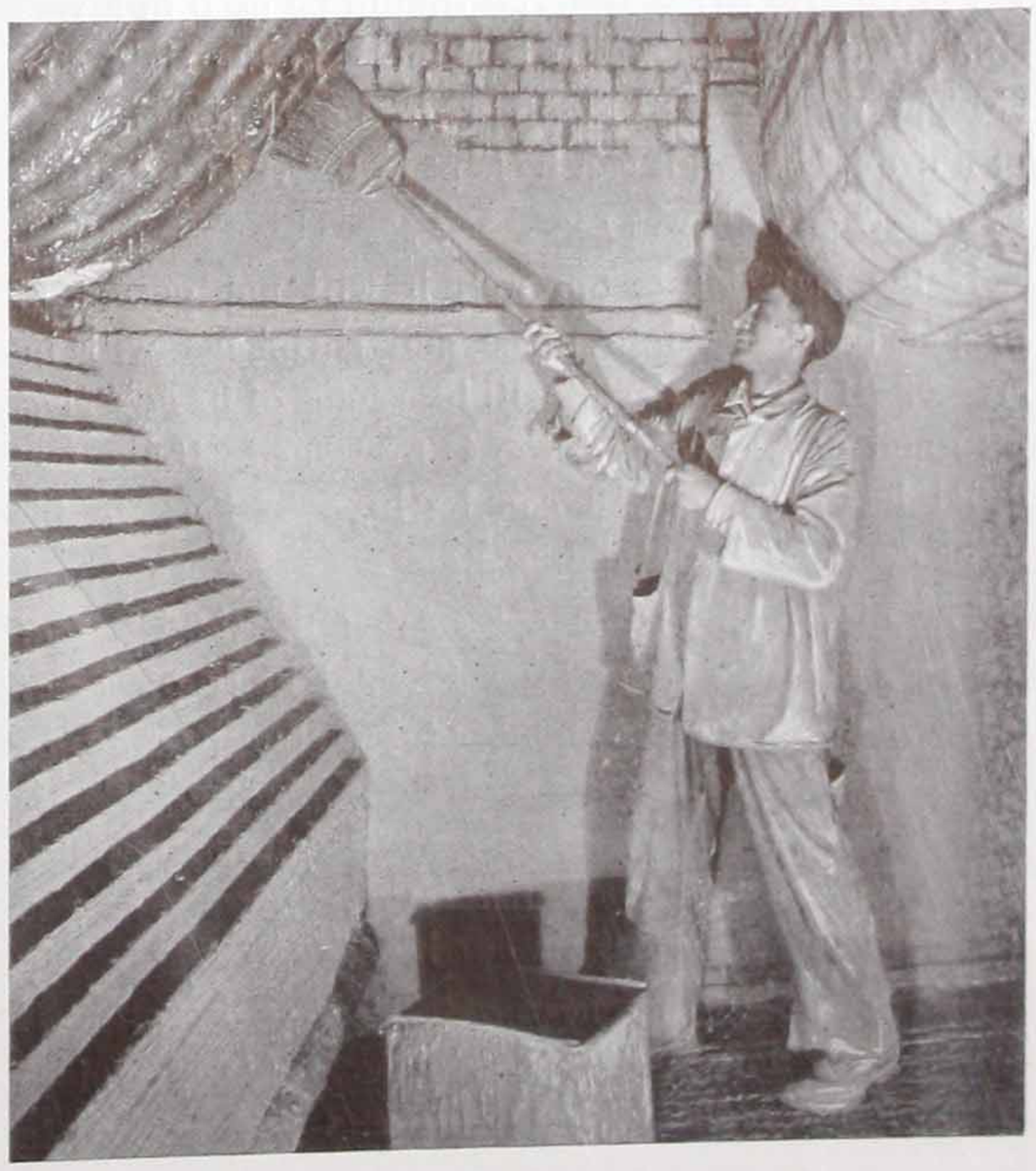
For brick-to-brick, or dipped joints No. 20, 32, 34 and Hellite is thoroughly mixed with water to a thick creamy consistency. The brick is wet and all faces which will come in contact with the brickwork already in place, are dipped in the mixture. Full directions are supplied with each shipment of refractory cement from the factory.

Wash-Coating Brick

Using No. 20, 32 and Hellite:

The setting is thoroughly cleaned and the cement mixed with sufficient water to bring it to a thin grout consistency. The mixture is applied to the face of the brickwork with a stiff brush or broom, working it well into the cracks and pores in the brick. It is important to apply the mixture thinly in order to prevent flaking.

Where old settings have to be scarified in cleaning, it is necessary to remove thoroughly all dust particles before wash-coating. This can be accomplished by carefully blowing out dust with an air gun or by hosing out the crevices and washing the walls with water.



Wash-coating with J-M Refractory Cement

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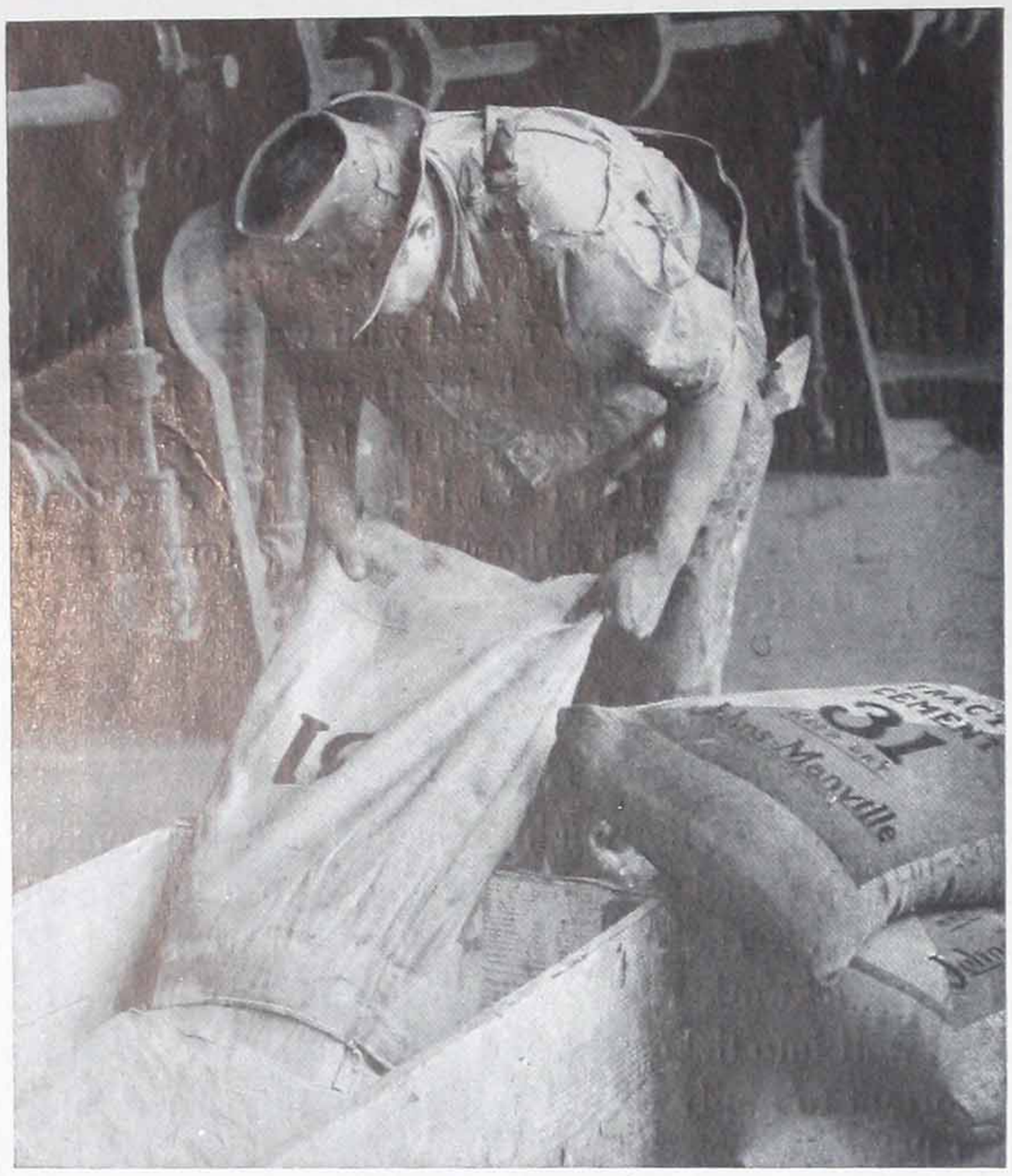


Refractory Cement should be thoroughly mixed with just the right amount of water

Refractory Patching

Using Plastic Fire Brick Material:

Plastic Fire Brick Material should be used in a very stiff plastic condition. It is shipped in the right consistency for use and if only a portion of the contents of a drum is used, it can be kept in the right condition by covering with wet rags.

If the material is too wet, it will not permit of proper pounding into place and shrinkage will increase. If it is too dry, it will lose some of its adhesiveness and proper vitrification is prevented. If the material has dried out, it can be brought back to the right consistency by adding water.

The old brick is torn out so that the thickness of the material will be at least 4″. All loose pieces of brick and mortar are removed and the part to be patched is washed down with water. Chunks of Plastic Fire Brick Material are then pounded into the patch with a wooden mallet. If material has become frozen, it should thoroughly thaw out before using.

Except on large patches no drying out period is required. For large patches, a slow fire is started to drive off the moisture gradually and then without a let-up, the furnace is brought up to operating temperature by the continuous, slow application of heat.

Using No. 20 Refractory Cement:

When it is desired to use up old fire brick as a patching material J-M No. 20 Refractory Cement is mixed with water to a soup consistency and crushed fire brick added. The fire brick should pass through a No. 4 screen (4 openings per linear inch). Both the fine and coarse particles should be mixed thoroughly with the cement to quite a stiff consistency. The best proportion is 35 percent of No. 20 and 65 percent of crushed fire brick. The directions for application of this mixture are similar to those for patching with Plastic Fire Brick Material which also appear on this page.

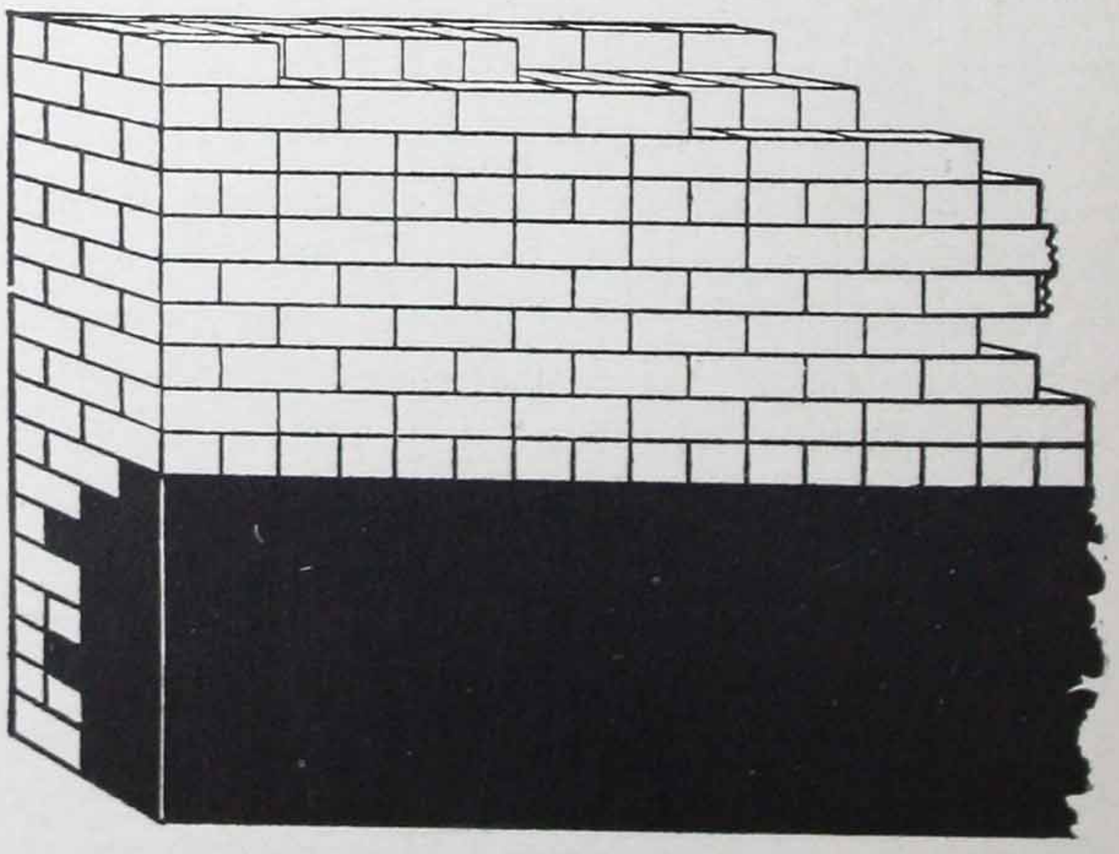
Using Hellite Refractory Cement:

J-M Hellite Refractory Cement is particularly adapted for hot or cold shallow patching. It is supplied in the right consistency for application to the brickwork by means of a long-handled paddle or trowel. The adhering qualities are excellent and a firm vitrified patch results.

Using No. 33 Super-Refractory Cement:

No. 33 is extremely resistive to the cutting action of oil flame and slag. It should be used only on old furnace walls that have been thoroughly cleansed of slag or cinder incrustation. Any glazed or smooth surface must be chipped away and well scarified before the cement is applied.

No. 33 should be thoroughly mixed with water to a dense mortar consistency and the mixture tempered by standing over-night, covered by wet bags. The cement should be applied with a trowel to a thickness of from ¼″ to ½″ depending upon the condition of the wall.



P.F.B.M. patches should be at least 4″ thick and well keyed into adjacent brickwork

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Firecrete

Casting special refractory shapes from Firecrete saves time, labor and expense

Firecrete is a dry, hydraulic-setting refractory cement used for monolithic construction. As it can be handled like a concrete mixture, it is adaptable for a wide range of industrial applications, being especially suited to pouring or casting special shapes, door linings, and pipe or flue linings. In some instances, it is used advantageously to replace construction that would be difficult and tedious to build with brick.

Special fireclay shapes are very expensive and require from 3 to 6 weeks to manufacture and deliver. Within the temperature limit of 2400 or 2800 deg. F., depending on the grade of material used, Firecrete replaces such shapes readily and at a minimum cost. It eliminates the necessity for carrying in stock a number of high priced special shapes which may only be used at irregular intervals.

Firecrete is easier to work than ordinary concrete

Three types of Firecrete are supplied: Standard, High Temperature (H. T.) and Light Weight (L. W.). Standard and H. T. Firecrete differ principally in temperature limit, while the L. W. has 40 percent lower heat-storage capacity.

Standard Firecrete

Standard Firecrete, recommended for temperatures up to 2400 deg. F., has the following characteristics:

Temperature Resistance:	
Highest working temperature	2400 deg. F.
Pyrometric cone equivalent 15-16	2600 deg. F.
Percent Linear Shrinkage:	
Oven-dried to 1750 deg. F.	0.0%
2250 deg. F.	0.5%

Material is gradated and calcined and will pass a 6-mesh screen (6 openings per linear inch). Because of its texture, Standard Firecrete should not be applied less than 1½″ thick.

Shipped in 100-lb. bags. Each cu. ft. of construction requires 110 lb. of Standard Firecrete.

For pouring or casting, 10 qts. (20 lb.) of clean, fresh water should be added per 100 lb. of Standard Firecrete. For tamped or rammed linings, 8 qts. (16 lb.) of water should be used.

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Application:

Excellent applications for Standard Firecrete include: furnace doors of all types; burner blocks; baffles; refractory slabs; kilns and waste heat flues; door and stand pipe linings; and combustion chambers for domestic oil burners and stokers.

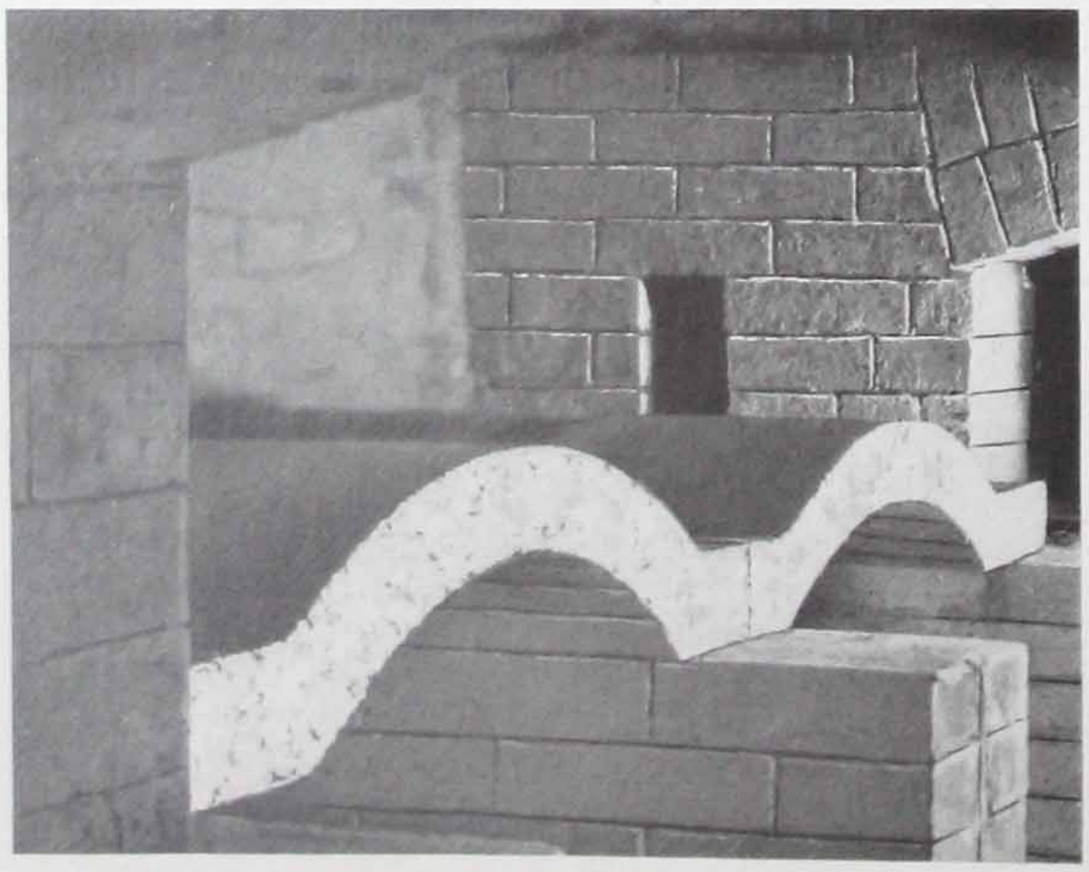
Pouring or casting is the accepted practice of placing Firecrete as it makes more homogeneous shapes, requires less labor and eliminates the possibility of failure due to inadequate ramming.

Forms for making shapes can be made either of wood or metal. If metal forms are used it is necessary to remove them before heat is applied. Wooden forms will burn away without damage to the refractory. If a number of shapes are to be poured or cast, a metal form is the more satisfactory as it can be used repeatedly. In many instances, it is advantageous to use a metal form made in two or three sections so that it can be conveniently removed.

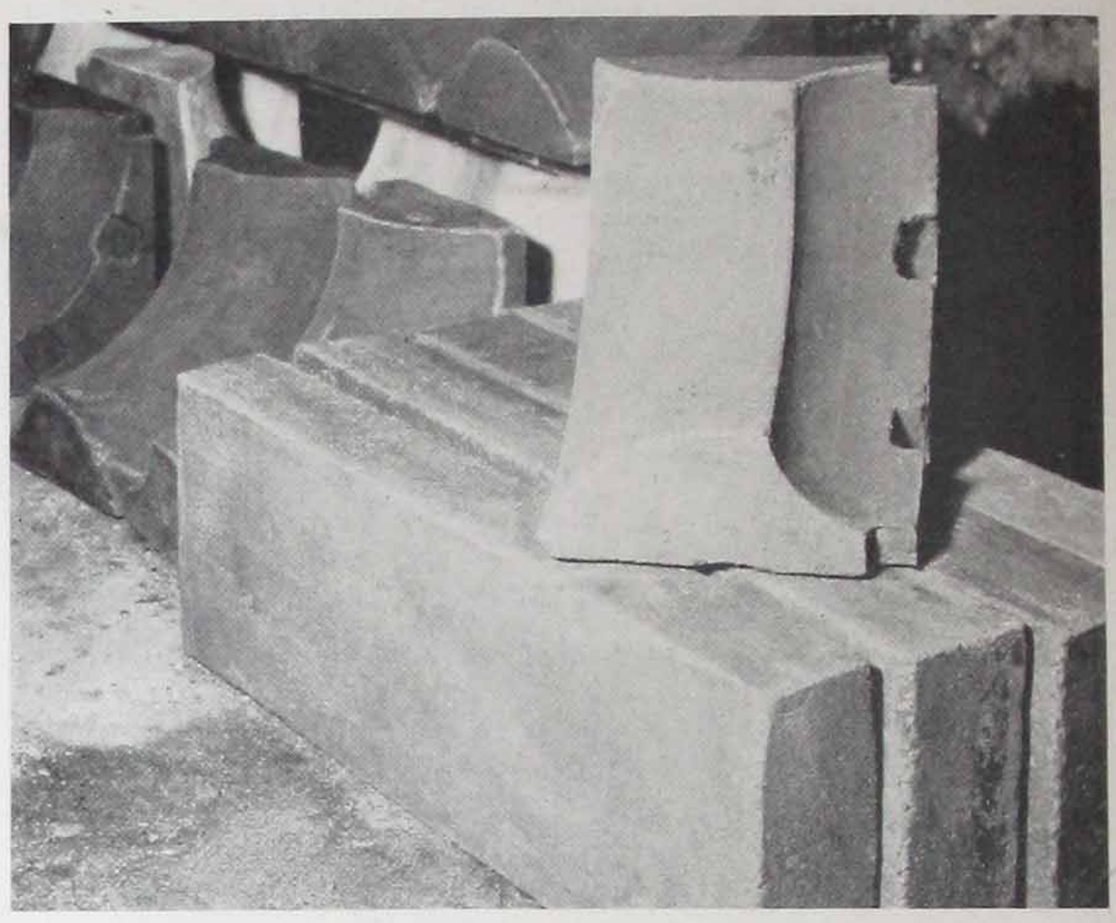
Forms must be well coated with oil so that they can be readily removed after the Firecrete has set.

Firecrete is highly resistant to spalling and has practically no drying or firing shrinkage. As it sets rapidly, it should not be mixed with water until the job is ready for the application of the refractory. If necessary, Firecrete, in six hours air curing, sets sufficiently to permit removal of forms. The addition of hot water greatly accelerates the set but is not recommended except when urgently necessary as it reduces considerably the ultimate compressive strength.

On small installations, 12 hours curing is preferable before heat is applied. On large installations the curing time should be extended to three days.



Approximately 22 hours after work began on the casting, this new baffle arch made of J-M Firecrete was installed



Large, massive forms are cast with comparative ease

In casting Firecrete, it is preferable to pour a complete section at one time to prevent stratification. If the material has set, the surface must be scarified to insure a bond with the fresh material.

When Firecrete blocks or special shapes are used in the construction of refractory walls, they should be laid in J-M Hellite Refractory Cement.

H. T. Firecrete

H. T. Firecrete, or High Temperature Firecrete, is very similar in properties to Standard Firecrete, and is used and applied in the same manner.

The high temperature product is recommended for use between 2400 and 2800 deg. F. For temperatures below 2400 deg. F., Standard Firecrete should be used.

H. T. Firecrete has the following characteristics:

Temperature Resistance:	
Highest working temperature	2800 deg. F.
Pyrometric cone equivalent 30	3000 deg. F.
Percent Linear Shrinkage:	
Oven-dried to 2250 deg. F.	0.2%
2450 deg. F.	1.3%
2700 deg. F.	1.8%

H. T. Firecrete consists of selected, highly refractory, calcined material, all of which will pass a 3-mesh screen (3 openings per linear inch). Because of its texture, it should not be used less than 2″ thick.

Shipment is made in 100-lb. bags. For each cubic foot of finished refractory construction, 115 lb. of dry H. T. Firecrete are required.

For pouring or casting, 8-8.5 qts. (16-17 lb.) of clean, fresh water should be added per 100 lb. of H. T. Firecrete. For tamped or rammed linings, 7 qts. (14 lb.) of water should be used.

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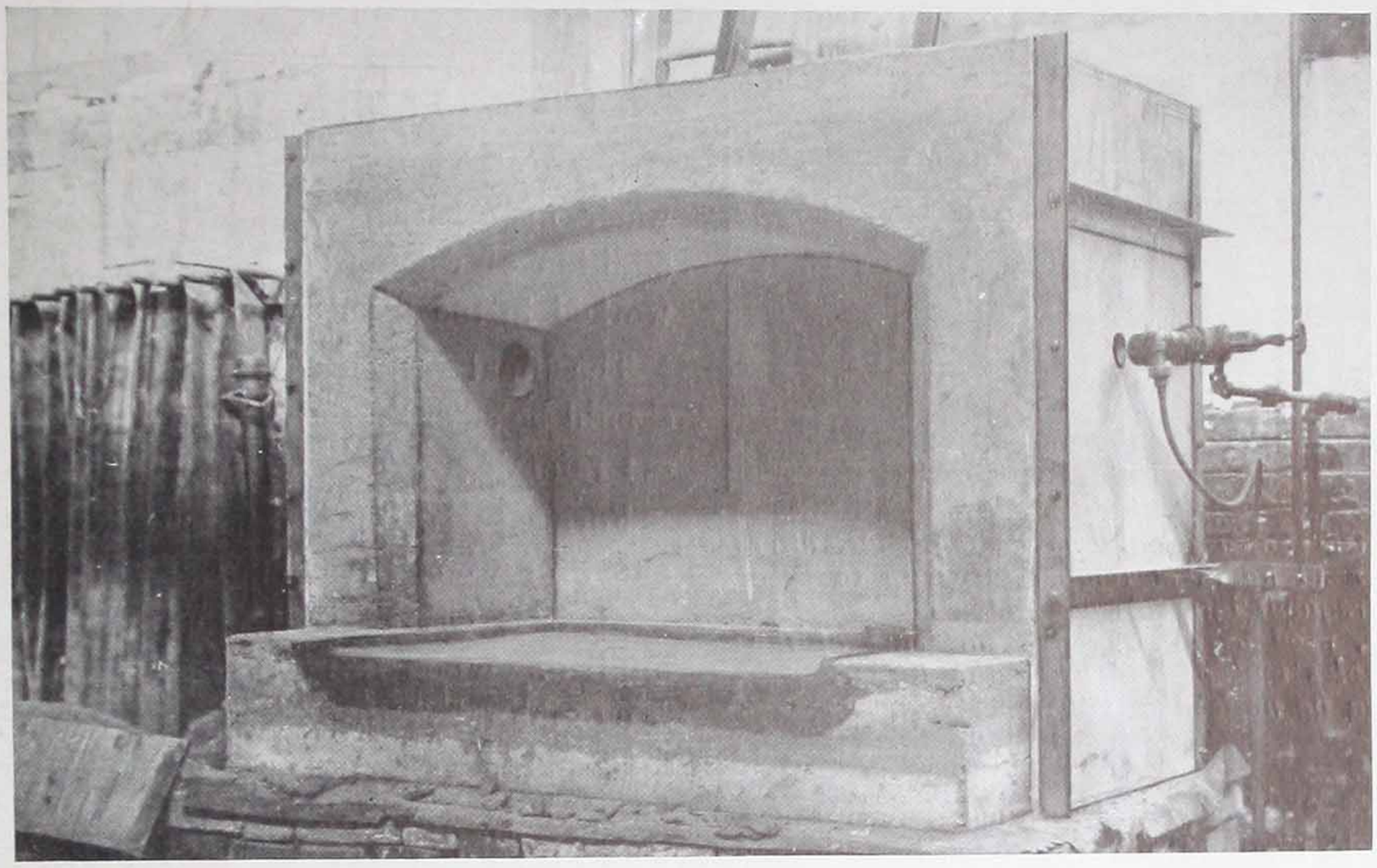
L.W. Firecrete



Oil-fired forge furnace with 9" walls, cast in one piece from L.W. Firecrete. The hearth was protected with a poured surfacing of a special neutral refractory. Flat Transite was used to make the outside form; the inside forms, including burner openings, were of wood. The illustration shows the furnace before firing

L.W. Firecrete, or Light Weight Firecrete, is a new development in dry, hydraulic-setting refractories for monolithic construction. It is 40% lighter in weight than fire brick and has a composition which is chiefly a pure clay of high alumina content, calcined at high temperatures. L.W. Firecrete has unusually low heat-storage capacity, low thermal conductivity and a working temperature limit of 2400 deg. F., in addition to possessing all of the other characteristics requisite to a first class refractory.

This material can be poured into any desired shape. It hardens rapidly under ordinary atmospheric conditions and, if necessary, can be placed in service after 12 to 24 hours of air-curing. L.W. Firecrete is furnished in 100-lb. bags. Only 75 lb. are required per cu. ft. of finished monolithic construction.

L.W. Firecrete has remarkable resistance to spalling and will withstand direct exposure to flame temperatures, but is not recommended for use where it will contact molten metals or highly abrasive materials. The properties of L.W. Firecrete are:

Low Heat-Storage Capacity:

L.W. Firecrete in place weighs approximately 75 lb. per cu. ft. as against 125 to 130 lb. for fire brick. Since the specific heats of these two materials are approximately equal, the heat-storage capacities (weight x specific heat x temperature rise) are directly proportional to the weight. Consequently L.W. Firecrete has 40% lower heat-storage capacity than fire brick.

High Working-Temperature Limit:

L.W. Firecrete is recommended for temperatures in service up to 2400 deg. F., although under test, its pyrometric cone equivalent is No. 19 or 2768 deg. F.

Low Linear Shrinkage:

Temperature, deg. F.	212	230	1200	1750	2000	2250	2450
Percent linear shrinkage	0	0	0	0.25	0.25	0.28	1.3

Relatively High Compressive Strength:

Temperature, deg. F.	212	230	1200	1750	2000	2250	2450
Lb. per sq. in.	950	605	345	230	240	360	1490

Freedom from Spalling:

L.W. Firecrete has exceptionally high resistance to spalling under accepted laboratory and service tests.

Low Thermal Conductivity:

L.W. Firecrete has less than half the conductivity of fire brick, as is evident in the following comparison

L.W. FIRECRETE
May, 1937 (Cancelling 2–C–1–E–0.1 [RE–45] dated October, 1934)

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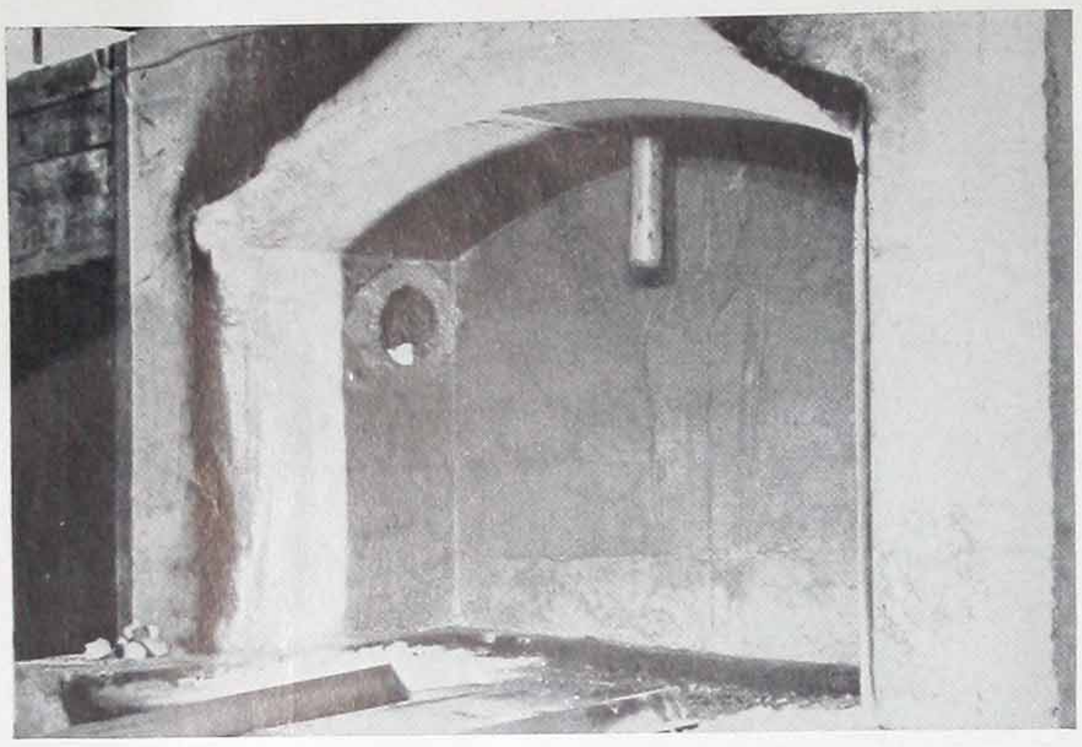


The test furnace shown on the preceding page, after being fired for 50 hours at temperatures up to 2300 deg. F., with frequent intervals of sudden cooling. The H.T. Firecrete, used as a protective surfacing of the burner port holes and poured when the furnace was cast, can be noticed in the upper corner

of conductivities, expressed in B.t.u. per sq. ft., per 1″ thick, per deg. F. temperature difference between surfaces, per hour.

Mean temperature, deg. F.	L.W. Firecrete conductivity	Fire brick conductivity
400	2.82	6.43
800	2.98	7.35
1200	3.20	8.29
1600	3.48	9.21
2000	3.84	10.14

Uses of L.W. Firecrete

L.W. Firecrete is recommended for temperatures up to 2400 deg. F. to replace fire brick. It is especially suited to pouring small monolithic linings, special refractory shapes, and to replace construction difficult or laborious with brick.

Because of its low heat-storage capacity, it is particularly recommended for use in intermittently operated furnaces, while its low thermal conductivity makes its use also advantageous in continuous operation. On intermittent furnaces, a great quantity of heat is wasted in heating up heavy fire brick. This heat is lost when the furnace is shut down and allowed to cool. The employment of L.W. Firecrete saves 40 percent of this heat.

The light weight of the material, together with its other qualities, offers an opportunity for economical service as an insulating refractory roof for furnaces where such a possibility has not heretofore existed.

Directions for Mixing

L.W. Firecrete is prepared for use by mixing thoroughly with clean fresh water. The recommended water content is 25 percent or 12½ quarts of water per 100 lb. of L.W. Firecrete.

If an easier pouring consistency is required more water may be slowly added. However, after each addition of water, the mixture should be thoroughly worked in the usual manner.

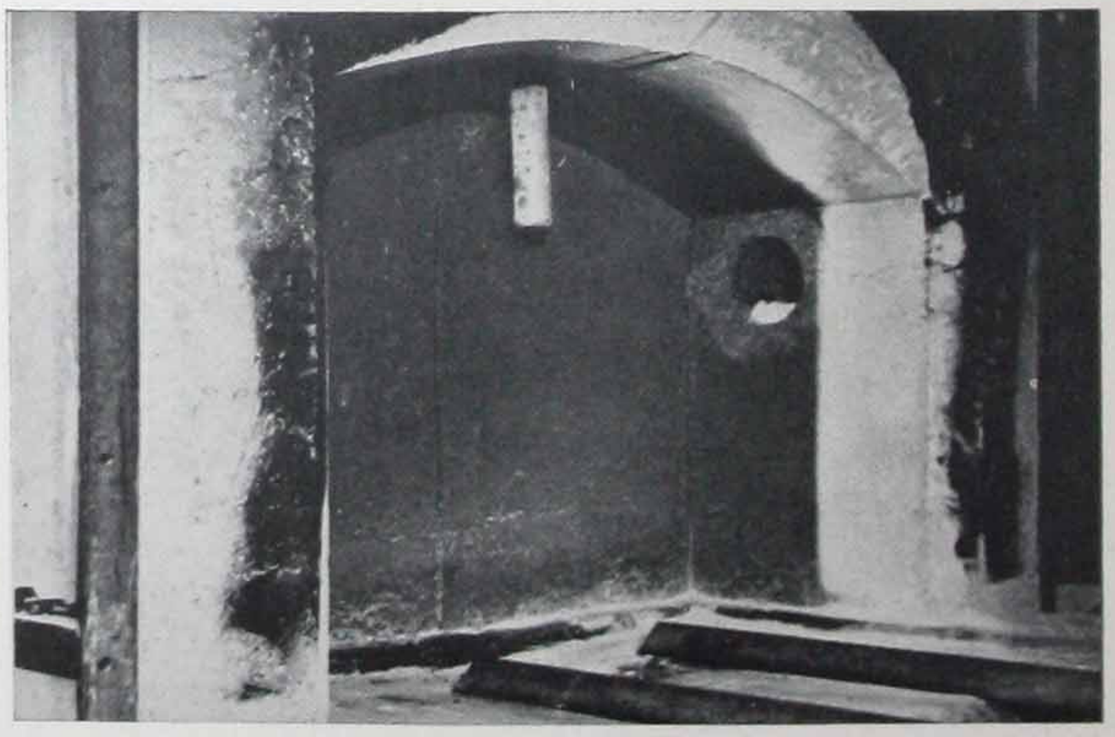
The final consistency of the refractory cement should be such that it will easily flow into place without ramming or tamping.

Forms for making shapes or linings can be made either of wood or sheet metal. If metal forms are used, it is necessary to remove them before heat is applied. Wood forms will burn away without damage to the refractory. If more than one shape is to be made, a sheet metal form is more satisfactory, as it can be used repeatedly. Metal forms must be well coated with oil so that they can be easily removed after the refractory has set. Wood forms should be shellacked and then oiled.

In pouring L.W. Firecrete, it is preferable to pour a complete section at one time to prevent stratification. If the material has set, the surface must be well scarified to insure a proper bond with the fresh material.

It is preferable to allow L.W. Firecrete to air-cure as long as possible but forms may be removed in six hours, and, if necessary, it can be put in service after 12 to 24 hours air-curing.

L.W. Firecrete hardens rapidly, so water should not be added until the job is ready for the application of the refractory material.



The same furnace after further intermittent firing to a temperature exceeding 2400 deg. F., with no signs of deterioration. It required only 24 minutes to bring the furnace up to 2400 deg. F. from room temperature

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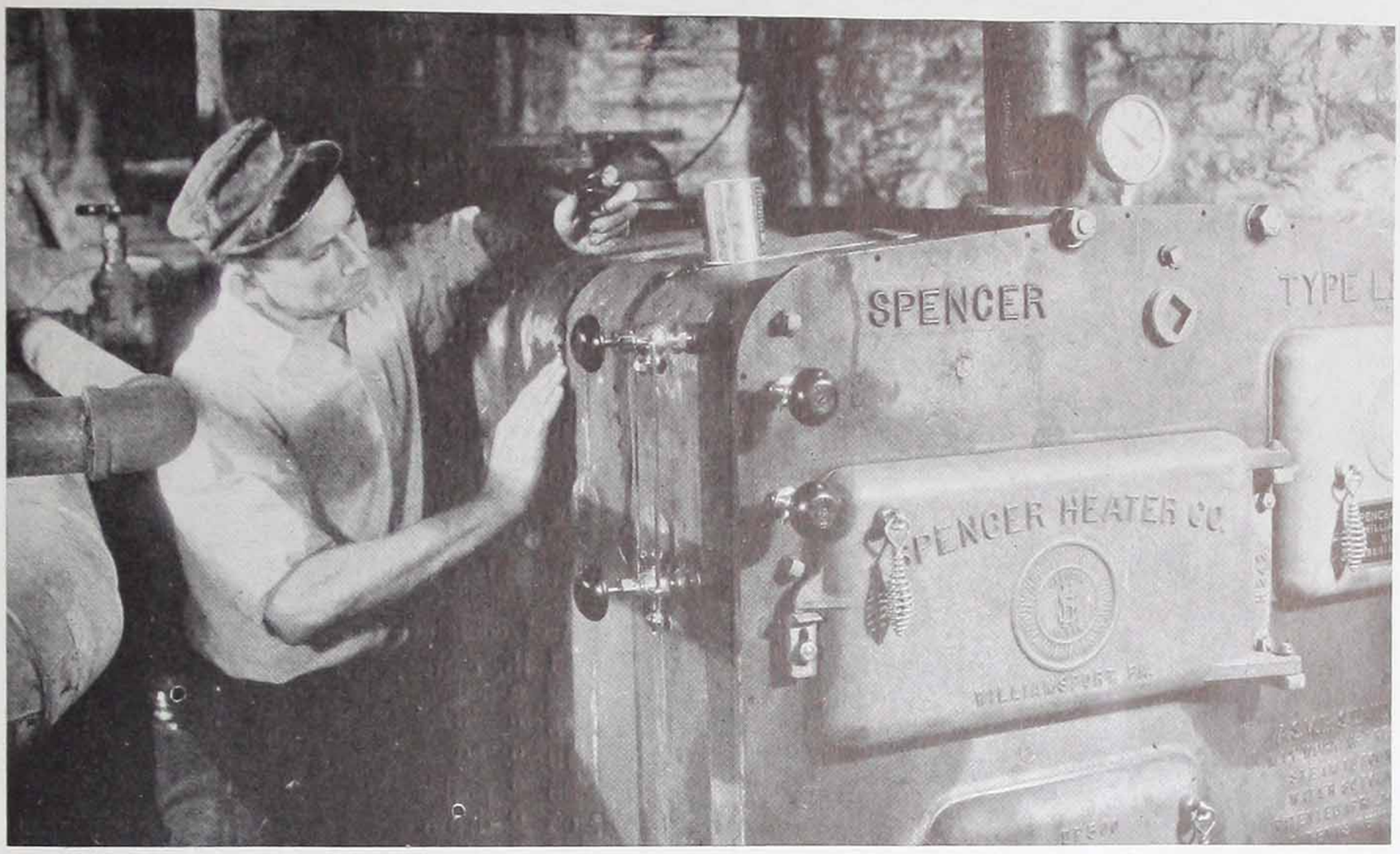
Fireite Asbestos Furnace Cement



Making the sections of a new boiler gas-tight with Fireite

Heating equipment cannot operate efficiently unless every joint is sealed—and sealed properly. Whether new equipment is being installed or old equipment repaired, one bad or leaky joint can spoil an otherwise excellent installation.

J-M Fireite Asbestos Furnace Cement, an asbestos compound developed by Johns-Manville for mounting and repairing joints in stoves, boilers, furnaces, heaters and ranges, provides the convenient, economical way to make joints gas, smoke and soot-tight.

On installations of oil burner and automatically stoked equipment, where complete combustion must be maintained at all times, the use of Fireite is an important safeguard against costly service calls.

Advantages of Fireite

Fireite has the following desirable characteristics:

1. It will withstand the highest service temperatures to which the equipment may be subjected
2. It will not crack, crumble or bloat under heat
3. It sets slowly, either under ordinary atmospheric conditions or under heat, and forms a hard, permanent gas-tight bond, which endures even under the strain of repeated expansion and contraction
4. It has no odor
5. It is easily applied and will adhere firmly to any clean surface
6. It keeps well on the bench

Fireite is supplied ready-for-use as a smooth buttery paste, in the following size containers:

Size of container	Cans per carton	Gross weight, lb.
1 lb. can	50	64
2 " "	25	63
3 " "	18	63
5 " "	12	69
10 " "	6	69
25 " pail	—	27
50 " "	—	54
100 " drum	—	105
250 " "	—	270
500 " "	—	530
850 " "	—	895

Mounting New Equipment with Fireite

When mounting or setting new equipment, before applying Fireite, the metal should be thoroughly cleaned and all paint, iron rust, grease and other foreign matter removed. Rust or paint may be scrubbed off with a stiff wire brush; any dirt should be brushed out of crevices; grease should be removed with gasoline.

Before mounting, it is preferable to apply a small quantity of Fireite, diluted with water to the consistency of paint, to all the metal surface of the joint with a brush or wet cloth. This will fill the slight surface defects which are commonly found in castings. The undiluted cement in the original form is then applied directly from the container, preferably with a spatula or putty knife. In all cases the cement must be firmly pressed against the metal.

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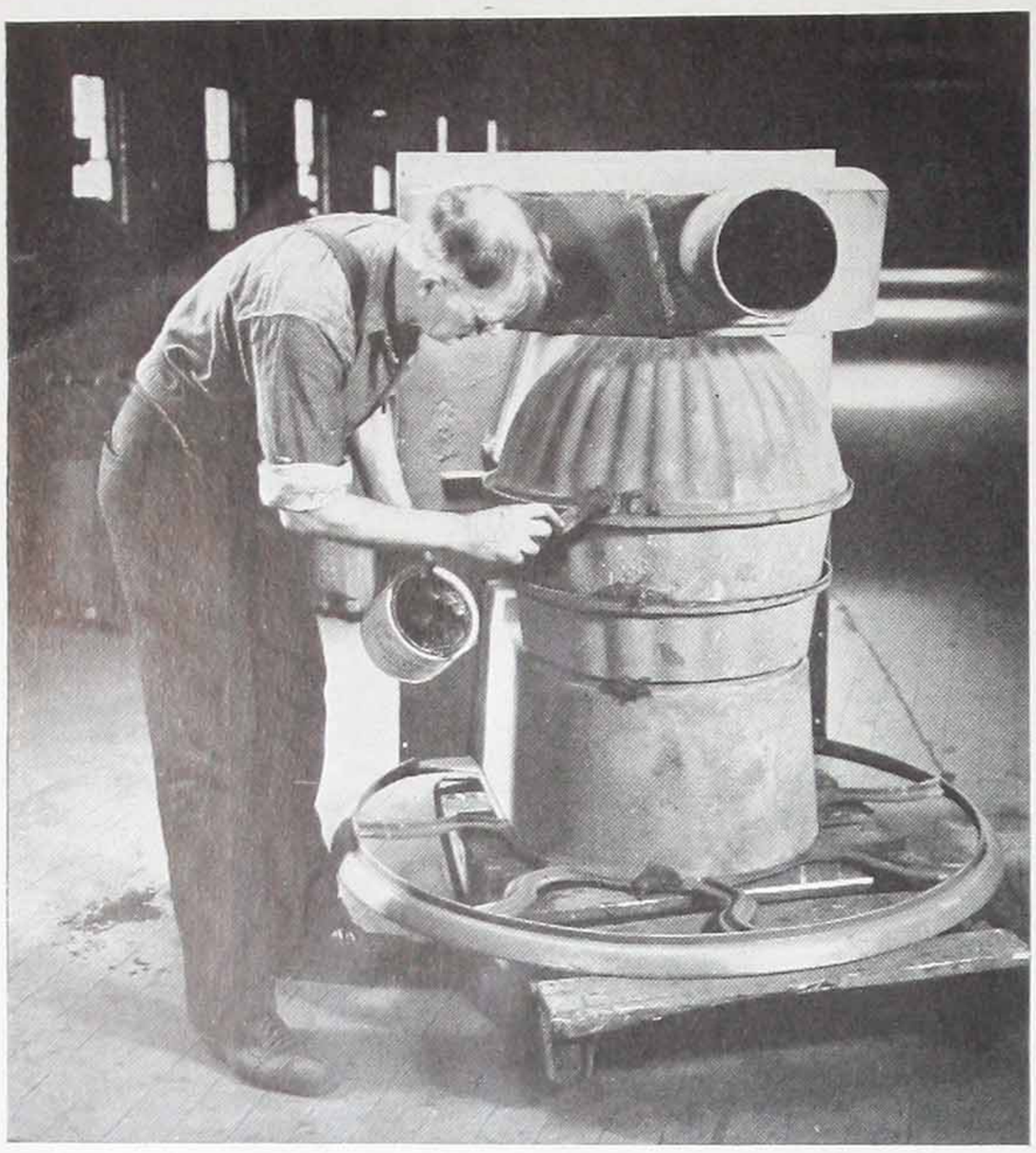

Mounting a hot-air furnace with Fireite. Each of the eight joints of this unit is thus made gas and smoke-tight

In assembling heaters or stoves, the entire joint should be filled with Fireite and the section allowed to settle into the cement with its own weight. It should not be twisted or jammed into place as this would tend to displace the cement from its proper location. When the section has settled into place, any cement which squeezes out should be smoothed off before it sets.

It is preferable to allow Fireite to harden for at least 24 hours before starting a fire. The cement will cure more uniformly if a slow fire is carried at first. Rapid initial firing is likely to cause a weak joint with any cement, and should be avoided.

Fireite Asbestos Furnace Cement may also be used to advantage for bonding refractory shapes in stoves and furnaces.

Repairing Old Equipment with Fireite

Heating contractors and plumbers have found from satisfactory experience that Fireite is as successful on old as on new equipment, for repairing and sealing joints. Fireite adheres firmly to any clean metal surface and can even be used for joining broken parts.

Fireite is also preferred in installing domestic oil burners and stokers, for sealing clean-out doors, flue pipe connections and other furnace parts; and proves efficient for bonding refractory hearth tile in rotary oil burners.

J-M Stove Putty

J-M Stove Putty is used for sealing joints on ovens and hot-water heaters where it is not apt to be exposed to intense heat. This material is an asbestos compound which is especially adapted to hand-rolling and running under the thumb. It does not stick to the fingers but adheres readily to metal.

J-M Stove Putty is supplied ready-for-use in the following size containers:

Size of container	Cans per carton	Gross weight, lb.
1 lb. can	50	63
2 " "	25	62
5 " "	12	70
10 " "	6	68
35 " pail	—	—
65 " drum	—	—
375 " "	—	—
675 " "	—	—

Under heat, J-M Stove Putty vitrifies and forms a permanent gas-tight joint, but it will not harden on the bench and keeps well in the container.

Repairing a leaking joint in old equipment with Fireite Asbestos Furnace Cement

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